The United Nations Scientific Conference for the Conservation and Utilization of Resources

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WHEN MORE THAN 600 scientists, economists, private businessmen, and government officials from 50-odd countries of the world met at Lake Success from August 17 to September 6 for the United Nations Scientific Conference for the Conservation and Utilization of Resources, it was thought that anything could happen. What did happen was not startling. There were almost no sharp clashes that created ready-made newspaper headlines, for those who took part were not concerned in this meeting with political ideologies. The organization of the conference must be considered a great tribute to the work of the Economic and Social Council of the United Nations, and to its Secretariat.

In opening the conference, Trygve Lie, United Nations Secretary-General, stated:

> Modern science has developed a wide range of new techniques for wresting more wealth from the earth's resources. Their effective application is basic to achieving a world of abundance—a world where the specters of hunger and wastelands will be things of the past.
>
> In particular, the underdeveloped areas of the world can reap the benefits of learning new methods to use their untapped resources and to build up their economies. The conference represents one of the first and most important steps in the program of technical assistance to underdeveloped countries, which the United Nations is undertaking.

What these world authorities talked about had to do with the material things necessary for the survival of man and his attainment of higher levels of living. What was said about the availability of resources was generally reassuring. There are a few materials which are now considered essential but which are believed to be insufficient to meet the world population's increasing demands. The possibility of new discoveries, the availability of substitutes of more plentiful materials, and the possibilities of conservation in use tended to alleviate the worries of those who were inclined to view the situation in great alarm.

The basis for this general optimism was founded upon the ingenuity, resourcefulness, and knowledge with which modern man is developing techniques for the conservation and use of the resources of the world. Reports of the tremendous advances that are being made in the techniques of production, processing, use, and conservation of resources of the world, as documented in the hundreds of scientific papers presented, proved that necessity was creating invention.

Colin Clark of Australia pointed out the race between the increasing world population and the world's food supply:

> While man has proved himself capable of the most appalling misuse of natural resources under certain circumstances, he has also shown himself capable of scientific improvement of agricultural technique capable of raising the product per man-year at the rate of 1½ percent per annum. Even in some of the crowded areas of Europe and Asia great increases in agricultural production have been achieved. The world's population is increasing at the rate of 1 percent per annum and our problem is clearly soluble if we go about it the right way.

A. I. Levorsen of the United States, summarized the outlook for petroleum reserves:

> Petroleum occurs in sedimentary rocks. The volume of sedimentary rocks found both on the land and under the shallow waters of the continental shelf areas bordering the continents may reasonably be expected to contain an amount of petroleum per unit volume comparable to what has been found in the sediments of the explored regions. The present estimates of the amount of the undiscovered reserve are on the order of 500 times the current annual world consumption. Such estimates merely reflect the state of technical development and geological understanding at the time of the estimate. As ideas have developed, estimates have increased and may be expected to continue to increase in the future.
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> These reserves must be discovered, to be of any use. Their discovery is determined by a combination of technological, economic, and political factors.

It was brought out time and time again that research, both fundamental and applied, must be increased if the demands of the world's increasing population are to be met. It was emphasized that research must include discovery, development, production, and use of resources if supplies of needed materials are to provide a basis for the attainment of higher levels of living. It appeared that the earth's resources and the ingenuity of man can provide an almost unlimited potential for improved living standards for the world's population.

But not all of the discussions painted such a rosy picture. Not all of the skill of the minerals scientist, whether he be geologist, mining engineer, or metallurgist, is being put to use in solving the problems of supplying metals and fuels essential to the attainment of higher levels of living. Only a small proportion of the energy available in the rivers of the world is being harnessed to supply power—power which is necessary if man is to produce the requirements for a more satisfactory life.

Tremendous strides are being made in the techniques of surveying forest reserves, in protecting forests from fire, and in the production and utilization of forest products. At the same time, forest resources continue to be destroyed in large scale through fires, insect ravages, and destructive harvesting methods. Decent housing for much of the world's population can be provided only if forest resources are carefully husbanded and utilized. Good forestry management can also supply paper essential to exchange of information among peoples of the world.

Papers dealing with soil resources brought out the disparity between the methods that have been developed for the production and conservation of soil fertility and the methods that are being used by the many millions of people who are trying to earn a living through cultivating the soil. Not only would these advanced techniques conserve the soil's fertility; they would even increase its productive capacity. If properly applied, this improved use of the soil, coupled with advancements in crop production and animal husbandry, could provide the necessary food and fibers to raise living standards for the world's increasing population.

It was also made clear that man need not look to the land alone for his requirements, for in the large part of the world's surface covered by the sea lie great potentialities for the production of food and other necessities. Yet today large populations are sorely undernourished while great unused quantities of fish are near by. In other parts of the world, marine resources are being destroyed by overexploitation.

The experts were in general agreement that, under most circumstances, it would be necessary to apply a combination of techniques involving a number of associated resources if such resources were to be conserved and used for the benefit of mankind. This principle seems to be true whether it is applied to a river valley or to the economy of a whole country or region. An example brought this out. Scarcity of fuel in one area had resulted in denuding the productive land of trees and shrubs that had protected it from desert encroachment. Hence, in this instance, the saving of productive soil became a question of finding an alternative fuel supply.

Thoroughgoing surveys and analyses are needed as a basis for planning resource developments. Without adequate surveys, a single resource may be developed for only one purpose, when further study may indicate that a number of purposes could be served by a single development. For example, in the rush of industrializing underdeveloped countries, a river may be dammed for power purposes without study of irrigation and flood control possibilities. In other instances, the conservation of soil fertility may be handicapped because of the lack of phosphates. Surveys may reveal that phosphate production must await development of transportation and power. Combined resource development was considered to be of particular importance in the underdeveloped countries.

Even though it was already agreed that this comprehensive approach is essential, the conference participants were unable to agree how a combined resource technique could best be applied in an underdeveloped country where technicians, skilled labor, and capital are limited. Roberto Vergara of Chile threw light upon the subject.

> A people must be considered the very first resource in any undertaking into industrialization. The structure of business and of government, the financial and political situation, and willingness or ability to carry forth programmes of development are the foundations of plans and statistics.

The importance of metal production and consumption to the attainment of high levels of living was examined. Howard A. Meyerhoff of the United States pointed out that:

> The rapid increase in the volume of metal production since 1914 has tempted experts to correlate metallic output and living standards. Upon analysis it is found that the correlation factor is low if based on production, and only moderately higher if based on consumption. Living standards depend upon productivity, which is a function of integrated regional economies. The natural or geographic regions that comprise the earth's economic units are unrelated to political boundaries, and integration is seriously impaired by artificial restrictions imposed by nationalistic interests. The expanding geography of metal supply demonstrates the international, rather than national, character of the world's economy; and if the production, processing, and utilization of metals are to make their proper contribution to improvements in living standards, there must be regulated but unrestricted exploration, exploitation, and movement of all essential raw materials and of the manufactured goods that foster higher productivity and create exchange.

It was found by comparison that there was wide variation between the levels of living attained by workers engaged in similar aspects of metal production in different regions of the world. Of the coun-

tries whose economies are based almost wholly on agriculture, not all can be characterized by a low standard of living. A high standard of living is dependent upon productivity rather than the presence of particular resources or combinations of resources in a political subdivision of the world.

The caloric content of a population's diet was thought to be a more realistic measure of the level of living than the per capita consumption of metals. Consequently, it appeared that present trends in some countries to develop a "well-rounded" economy by insisting upon developing mineral industries without adequate mineral resources were unsound. Proponents of industrial production have failed sometimes to understand that it is high productivity and not necessarily diversification of industries that creates the basis for high levels of living.

United States Secretary of the Interior J. A. Krug called attention to the fact that:

> . . . the peoples of the world want help in turning their best dreams into reality. There is demand everywhere for a fair chance to share in the opportunities which the world's scientists have opened up. People in the remotest hills and deserts have glimpsed the possibility of shifting some of their century-old, backbreaking labor over to machines and they are formulating the goals of a higher standard of living, of better education for their children, of a life that contains some leisure, pleasure, and promise.
>
> None of us should underrate the force of this great popular longing. It is one of the major facts of this century. It crosses national boundaries. It pervades groups in all communities. It is dynamic. It pushes organizations and governments into action.

The techniques discussed, if applied to the problems of populations of underdeveloped countries, would greatly increase the level of economic activities which would support higher levels of living. However, the obstacles to the application of a particular technique in these circumstances were considered to be very great indeed. For example, a very high percent of the total population in many underdeveloped countries is engaged in what is known as "subsistence agriculture." This population is made up of families which produce their own food, clothing, and shelter but which either have no surplus for sale or have a surplus for which no markets are available because of lack of transportation or other reasons. In many cases such families are not producing enough food for themselves. With commercial fertilizers they could produce more food but even if they were able to produce more than they needed it could not be sold until marketing facilities were developed. Consequently, these families would have no money to pay for the increased fertilizer.

The scientists struggled with the problem of breaking into this vicious circle and were unable to find any solution that could be readily applied. But they did throw a great deal of light upon the nature of the problem. In most cases the amount of arable land per family is too small to yield surpluses to pay for fertilizer and other requirements for increased productivity and higher levels of living. Poor health, caused by malnutrition, improper sanitation, and other dangerous hygienic conditions, results in lack of energy—another segment of a vicious circle.

Experts at the conference who have worked in widely dispersed areas of the world firmly believe that the application of scientific techniques to primitive conditions can benefit not only the populations concerned but the whole world economy. However, they also agree that scientific techniques must be adapted to meet the physical conditions in a particular locality and must be presented to the populations concerned in such a way that the techniques will not only be understood but will be accepted. It was repeatedly said that a beginning must be made where the people are.

A representative from Israel, in commenting upon the prevalence of illiteracy throughout populations of the world, suggested that the beginning of the application of scientific techniques had to be made in teaching the populations to read and write. The transmission of new ideas is almost impossible, or at least greatly impeded, if the recipients of valuable information are unable to read or write. In making this statement, this conference participant was saying the same thing that others had said in different words —that the hope for the conservation and wise use of the world's resources is dependent upon the rapidity with which educational opportunities are extended throughout the world.

To some attending the conference it seemed surprising that scientists who would come to the conference to discuss purely technical subjects dealing with physical resources were interested in the discussions that dealt largely with the education of illiterate people. But as the discussions proceeded it became clear that ignorance was resulting in permanent loss of world resources, was retarding the demands for industrial products, and was preventing the development of a skilled labor force, which is essential to industrial production. It was clear that the rivers can be harnessed to produce power for industry. But unless there is available a skilled labor force to combine the power thus produced with the raw materials of the area, the production of the power is not economical. Further, if needed products are produced but cannot be marketed because the population lacks buying power their production is unprofitable.

In addition to defining some of the common denominators of economic development many corollary benefits were derived from the conference. The world's leaders in resource development became better acquainted. Frank and open discussion was possible. Time was not wasted in quibbling over words but was put to use in weighing ideas. The proceedings of the conference, to be published in a number of languages, will become a lasting source of technical information and practical ideas for applying scientific techniques toward world-wide resource conservation and use.

Although this conference was called long before President Truman's inaugural address, in which he proposed "a bold new program" for the development of the world's resources, especially in underdeveloped countries, it came at a particularly advantageous time —when the nations of the world are considering how to carry out such a program.

Age Determinations by Radiocarbon Content: Checks with Samples of Known Age

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FURTHER TESTS of the radiocarbon method of age determination (*1–3, 6, 8, 10*) for archaeological and geological samples have been completed. All the samples used were wood dated quite accurately by accepted methods. The measurement technique consisted in the combustion of about 1 ounce of wood, the collection of the carbon dioxide, its reduction to elementary carbon with hot magnesium metal, and the measurement of 8 grams of this carbon spread uniformly over the 400-square-centimeter surface of the sample cylinder in a screen wall counter (*7, 9*). The background count was reduced during the latter part of the work to 7.5 counts per minute (cpm), which is some 2 percent of the unshielded background, by the use of 4 inches of iron inside 2 inches of lead shielding, plus 11 anticoincidence counters 2 inches in diameter and 18 inches long, placed symmetrically around the working screen wall counter inside the shielding. The screen wall counter had a sensitive portion 8 inches in length, so the long anticoincidence shielding counters afforded considerable protection on the ends. No end counters were used. The data obtained are presented in Table 1 and Fig. 1.

The youngest sample used was furnished by Terah L. Smiley, of the University of Arizona Laboratory of Tree-Ring Research. It was a sample of Douglas fir excavated by Morris in the Red Rock Valley in 1931, the exact location being Room 6 of the Broken Flute Cave. The inner ring date is 530 A.D. and the cutting date is 623 A.D.

The next sample was furnished by John Wilson, of the Oriental Institute at the University of Chicago, and was a piece of wood from a mummiform coffin

TABLE 1

AGE DETERMINATIONS ON SAMPLES OF KNOWN AGE

Sample	Specific activity (cpm/g of carbon)		Age (years)	
	Found	Expected	Found	Expected
Tree Ring	11.10 ± 0.31 11.52 ± 0.35 11.34 ± 0.25 10.15 ± 0.44 11.08 ± 0.31 Average : 10.99 ± 0.15	10.65	1100 ± 150	1372 ± 50 (577 ± 50 A.D.)
Ptolemy	9.5 ± 0.45	9.67	2300 ± 450	2149 ± 150 (200 ± 150 B.C.)
Tayinat	8.97 ± 0.31 9.03 ± 0.30 9.53 ± 0.32 Average : 9.18 ± 0.18	9.10	2600 ± 150	2624 ± 50 (675 ± 50 B.C.)
Redwood	8.81 ± 0.26 8.56 ± 0.22 Average : 8.68 ± 0.17	8.78	3005 ± 165	2928 ± 52 (979 ± 52 B.C.)
Sesostris	7.73 ± 0.36 8.21 ± 0.50 Average : 7.97 ± 0.30	7.90	3700 ± 400	3792 ± 50 (1843 ± 50 B.C.)
Zoser : Sneferu		7.15	4750 ± 250	
Zoser	7.88 ± 0.74 7.36 ± 0.53			4650 ± 75 (2700 ± 75 B.C.)
Sneferu	6.95 ± 0.40 7.42 ± 0.38 6.26 ± 0.41 Average : 7.04 ± 0.20			4575 ± 75 (2625 ± 75 B.C.) Average : 4600 ± 75 (2650 ± 75 B.C.)

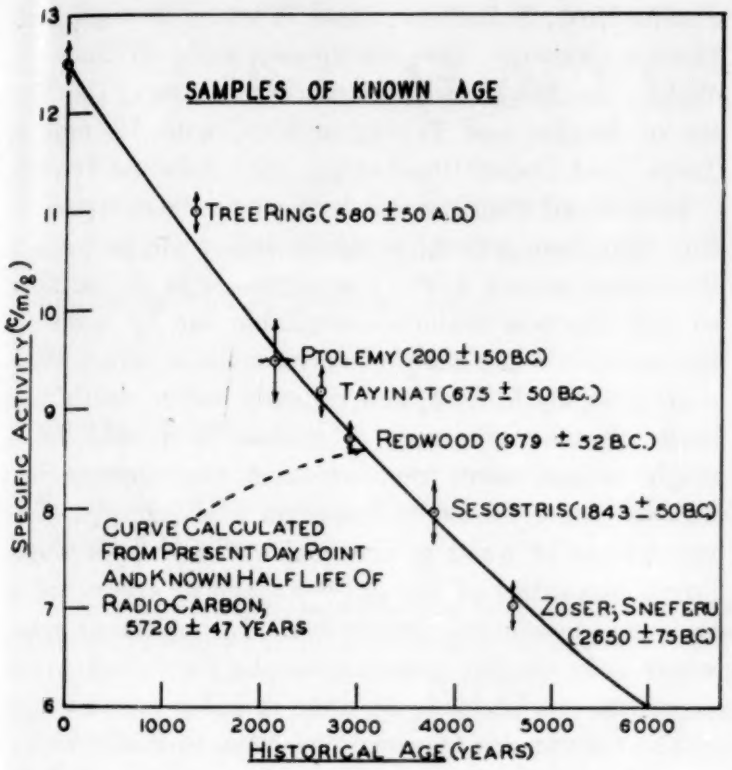

FIG. 1. Specific activities for samples of known age.

from Egypt, dated on stylistic grounds in the Ptolemaic period 332–30 B.C. It was measured quite early in our research, when the sensitivity of the instrument was somewhat less, and so the error is larger and only one measurement was made.

The next sample was furnished by Robert Braidwood, of the Oriental Institute, and consisted of two fragments of wood (*Pinus halepensis*) from the floor of a central room in a large *hilani* (palace) of the Syro-Hittite period in northwestern Syria. Prof. Braidwood dated the material between 725 and 625 B.C. from an imported Corinthian alabastron fragment, together with a great deal of historical evidence. This sample was measured with considerable care and with our most sensitive instrument. The agreement seems to be satisfactory.

The redwood sample was furnished by Edmund Schulman, of the Laboratory of Tree-Ring Research at the University of Arizona. It was a fragment of the inner part of a *Sequoia gigantea* tree felled in 1874 A.D. It is known as the Centennial Stump and has been described by A. E. Douglass (*4*). The sample furnished carried a sequence of rings from 1031 to 928 B.C.

The fifth sample was a piece of deck board from the funerary boat of the Egyptian Sesostris III, which is displayed in the Chicago Natural History Museum. The wood probably is cedar of Lebanon. The sample was kindly furnished to us by the museum through the good offices of C. C. Gregg and Alex Spoehr. John Wilson dated the material as 1843 ± 50 B.C.

The last sample, really being two samples, was described, with measurements, in an earlier publication (*10*). One of the two was from the tomb of Sneferu of Meydum (furnished by Froelich Rainey, of the University of Pennsylvania Museum in Philadelphia), which was 4575 ± 75 years old. The other was from the tomb of Zoser at Sakkara (furnished by Ambrose Lansing, of the Metropolitan Museum in New York City), which was 4650 ± 75 years old. The former sample was cypress wood and the latter acacia. The dates were given by John Wilson.

The agreement between prediction and observation is seen to be satisfactory. The errors quoted for the specific activity measurements are standard deviations as computed from the Poisson statistics of counting random events. One of the six average values, and seven of the 17 individual runs, differ by more than one standard deviation unit from the predicted value. Since in a long series of measurements 32 percent may be expected to fall outside this limit, we may conclude that the statistical error is the major source of scatter. Thus the deviation in the Douglas fir tree-ring sample should not be considered significant.

The errors quoted in the column "Age (years)" of Table 1 include also the uncertainties in the (relative) value of the present-day specific activity, and in the value of the half-life of C^{14}.

At intervals throughout the work, samples of anthracite coal were measured and no significant radioactivity was ever found. This served as a check on possible sources of contamination in the course of the measurement, such as chemicals used in processing, and the necessary exposure to air during the handling of the material.

These results indicate that the two basic assumptions of the radiocarbon age determination method—namely, the constancy of the cosmic radiation intensity and the possibility of obtaining unaltered samples—are probably justified for wood up to 4600 years. The fact that the most ancient samples agree with the predicted value shows that the cosmic ray intensity has been constant to within about 10 percent for periods up to 20,000 years ago. This refers to variations over intervals comparable with the half-life of radiocarbon, 5720 ± 47 years (*5*); it is obvious that shorter time variations would average out and would not affect the measurements.

The *Sequoia gigantea* sample has an additional interest of its own in that the wood spent most of its time at the heart of a live tree, and if any chemical processes had occurred involving the inner heartwood the specific radioactivity would have been elevated above the value found. In other words, this check apparently shows that the redwood heartwood is truly dead and does not partake in any of the metabolic

processes of the tree. This finding is not surprising to most botanists.

These results seem sufficiently encouraging to warrant further investigation and application of the method. We have been assisted in this work from the beginning by a committee of the American Anthropological Association and the Geological Society of America, consisting of Frederick Johnson, chairman, Donald Collier, Richard Foster Flint, and Froelich Rainey. This committee advised us what samples of known age to use for testing and greatly assisted us in procuring them. The attempt to establish the method for the great unknown periods of prehistory has involved further work with this committee and the majority of our decisions and efforts to date on unknown samples have been directly connected with their efforts. It was decided that the proof of the method in periods older than 5000 years, for which there are no generally accepted dates for testing, would have to be obtained by checks of internal consistency from a wide variety of samples and in a wide variety of problems. Eleven different major dating questions were selected for this purpose and prominent investigators in each case were invited to collaborate in the research. The problems selected were: Early Man, with Frank H. H. Roberts, Jr.; California–Oregon, with Robert Heizer; Hopewell–Adena, with James Griffin; Mankato, with Richard Foster Flint; Mesopotamia and Western Asia, with Robert Braidwood; Peru, with Junius Bird; Scandinavia and Western Europe, with Hallam Movius; the Southeast, with William S. Webb; the Yukon, with Frederick Johnson; the Valley of Mexico and Tepexpan Man, with Helmut de Terra; and Pollen Chronology, with Edward Deevey.

It is hoped that investigators who have samples fitting into these general problems will write to the collaborators named, to the committee, or to the authors, so that the best materials available can be used for the research. The samples may consist of wood, charcoal, peat, cloth, flesh, and possibly antler, teeth, and shell. Since ten grams of carbon is needed for a single measurement and at least two independent measurements should be made on each sample, some two ounces of wood or charcoal and correspondingly larger quantities of the other materials, according to their carbon content, are needed. In important cases, where only smaller amounts can be furnished, measurements can be made at some sacrifice of accuracy.

The authors are extremely grateful to E. C. Anderson, whose contributions to the development of the technique of measurement were very great. Also, thanks are due Robert Merrill and Richard Wolfgang for assisting in the measurements. The research has been and is now supported in large part by a grant from the Viking Fund, Inc., of New York City. It is hoped that during the next year a decisive test of the method for the prehistoric periods up to 20,000 years will be obtained through the investigations described.

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TECHNICAL PAPERS

An Inverse Decibel Log Frequency Method for Determination of the Transfer Functions of Psychobiological Systems[1]

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In previous papers, the writer has proposed the concept of transfer function for representing psychological and biological systems, in a manner analogous to its use for representing linear physical systems, such as servosystems and electrical networks (*9, 12*). It was pointed out that such transfer functions could, in principle, be derived on a purely empirical basis, in view of the fact that a one-to-one correspondence exists between the transfer function of a linear system and its response to specific input functions. The present paper describes a method by means of which the transfer functions of lumped constant linear systems can be derived from experimentally determined frequency response curves. Although developed primarily for use in deriving the transfer functions of the response systems of living organisms, it is applicable to any system that can be regarded to a first approximation as a lumped constant linear system, without regard to the type of components of which it is made up, whether living or nonliving.[2]

The method to be described rests on concepts and procedures involved in the so-called decibel (db) log frequency method developed for analysis and synthesis of servosystems and analogous networks. This latter method is hereafter referred to as the direct db-log frequency method in contrast to the method to be described in the present paper, which we designate as an inverse db-log frequency method.

As the names imply, the goals and procedures in the two methods are opposite to each other. In the direct method, an analytical transfer function, like that shown in equation (1), is given, and the problem is to plot the gain and phase frequency response curves corresponding to this function. In the inverse method a gain-frequency response curve (experimentally determined) is given, and the problem is to derive the analytic transfer function represented by this curve.[3] This latter procedure is equivalent to finding the differential equation representing a system from the specification of the solutions of the equation for a particular set of input functions.

$$P(s) = \frac{30s + 10}{2s^3 + 4.5s^2 + s} \qquad (1)$$

As a preliminary to the description of the inverse method, a number of the terms and procedures involved in the direct db-log frequency method should be clarified—namely, transfer function, asymptotic frequency response curve, exact frequency response curve, and the db corrections which must be made for points in the asymptotic curve to derive the exact curve. For a fuller description of the direct method and discussion of these concepts, reference should be made to recently published expositions of servotheory (*2, 5, 6, 7, 8*).

A key concept is that of transfer function. It is a mathematical function representing the properties of a given system. The standard way of deriving it is to write the differential equation of the system, convert it to operational form through the application of the Laplace transformation or an equivalent procedure, and then find, by elementary algebraic operations, the ratio of the output to the input functions (*8*). Examples, in factored form, and with nondimensional parameters, are given in equations (2) and (3). Equation (3) is derived from Equation (2) by substituting $j\omega$ for the complex variable s. The transfer function, as given on the right-hand side of each of these equations, contains only the independent variable s (or $j\omega$), and time constants such as T_1, T_2, $\ldots T_k, \ldots T_n$, representative of the components of the system and their organization. The transfer function thus provides a compact representation of the system itself, and a means for predicting the response of the system to any arbitrary input disturbance or stimulus (*4, 8*).

$$\frac{Y(s)}{X(s)} = K \frac{(T_2 s + 1)}{s(T_1 s + 1)\ (T_3 s + 1)} \qquad (2)$$

$$\frac{Y(j\omega)}{X(j\omega)} = K \frac{(j\omega T_2 + 1)}{(j\omega)\ (j\omega T_1 + 1)\ (j\omega T_3 + 1)} \qquad (3)$$

In plotting frequency response curves by means of the direct db-log frequency method, three steps are involved: formulation of the transfer function in factored form (equations 2 and 3), construction of an asymptotic db-log frequency curve made up of straight line segments, and construction of an exact db-log frequency curve on the basis of corrections made in the asymptotic curve.[4]

In the factored form of the frequency transfer function

[1] The research program of which this study is a part was aided by a grant from the Penrose Fund of The American Philosophical Society.

[2] A lumped constant linear system may be defined as one that can be described by a linear differential equation with constant coefficients.

[3] The method described here relates only to the gain-frequency curve and not to the phase curve. In a minimum phase system, the phase curve can be derived from the gain curve (*1*). A number of alternative terms have been used in place of gain, such as amplitude and modulus. Thus the db-log frequency method has also been called the log modulus method (*2*). A gain curve, measured in db units and with a change in sign, may also be referred to as a loss or attenuation curve.

[4] The term *frequency*, as used in this paper, is taken to mean the angular frequency ω, measured in radians per sec. It is equal to $2\pi f$, where f is measured in cycles per sec.

(equation 3), factors of the following three types may occur: $(j\omega)$, $(j\omega T_k+1)$, and $(j^2\omega^2T_q^2+j\omega 2\zeta T_q+1)$, the last being a quadratic factor which equals the product of two single order factors with conjugate complex roots. Each of the various types of factor may appear in numerator or denominator and with integral exponents equal to or greater than one. There can be only one of the $(j\omega)$ terms present, but any number of the other two types of factor. The single order time-constant factors differ from each other only in the value of the time constant T_k.

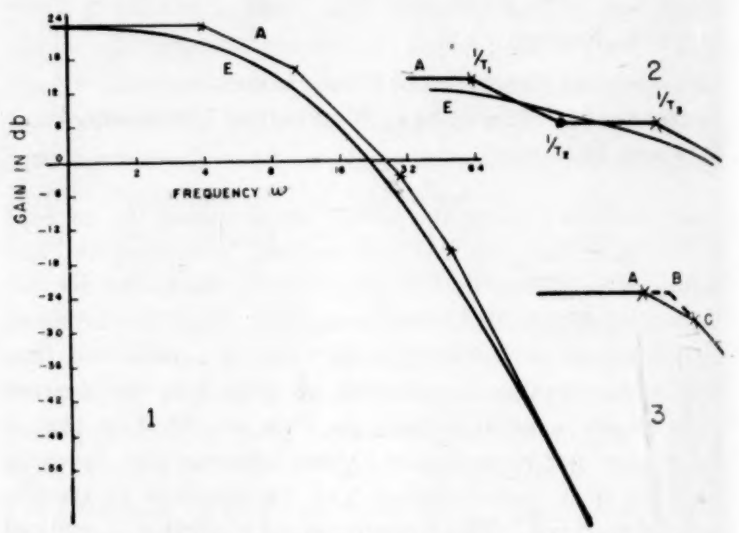
The straight line segments of which the asymptotic curve is composed all exhibit slopes of some multiple of 6 db per octave. The points at which they intersect are referred to as corner points or break points. There is one such corner point for each time-constant factor in the transfer function, the frequency coordinate of the corner point being equal to the inverse of the corresponding time-constant, e.g., $1/T_1$, $1/T_2$, and so on.

In one procedure for constructing the asymptotic frequency curve from the transfer function, one starts at the low frequency end with a line coincident with the 0 db axis, and continues it until the first corner point, located at ω equal to $1/T_1$, corresponding to the largest time constant. A second straight line segment is drawn from here to the next corner point, located at ω equal to $1/T_2$, T_2 being the next largest time constant, and so on. At each successive break, the following segment is drawn with a slope differing from the previous segment by $6n$ db per octave, where n is the exponent of the time-constant factor represented. The sign of the increment in slope is negative for factors in the denominator and positive for factors in the numerator. If there is a $(j\omega)$ term in the transfer function, the initial straight line segment has a slope of plus or minus $6m$ db per octave instead of 0 db per octave, where m equals the order or exponent of the $(j\omega)$ factor; and the slope is negative if the factor is in the denominator. This asymptotic plot is of great importance in connection with our present problem, since it places in evidence, at the various corner points, the values of the time constants which characterize a given transfer function.

An additional set of relations that we shall need to utilize in our inverse method relates to the db corrections (ε) that must be made at each corner point in the asymptotic curve in order to find the corresponding point on the exact frequency curve. The total correction at any value of ω equals the algebraic sum of the corrections due to *each* time-constant factor in the transfer function. The magnitude of the correction *for each factor* is given by equation (4). This quantity should be added to the asymptotic curve at any value of ω to obtain the corresponding point on the exact curve. Its sign is negative for factors in the denominator and positive for factors in the numerator. The smaller the interval between ω and $1/T_k$ on a logarithmic scale, the greater is the correction required for the factor containing T_k. Hence, if a set of corner points are densely distributed on the log ω axis, the net correction at the various corner points will be correspondingly high.

$$|\varepsilon| = 10\log_{10}(\omega^2T_k^2+1), \text{ for } \omega T_k \leqq 1 \quad (4)$$
$$= 10\log_{10}(\omega^2T_k^2+1) - 20\log_{10}\omega T_k, \text{for } \omega T_k \geqq 1$$

We may now consider the inverse method. Its design and the justification for the various steps proposed rest on the following set of principles. The over-all *asymptotic* curve of any transfer function is the algebraic sum of the asymptotic curves representing each of the component factors in the transfer function, due to the fact that these curves are logarithmic plots (in db) of the factors in the transfer function.[5] Similarly, the over-all



FIGS. 1, 2, and 3. 1—Relation of asymptotic (A) and experimental (E) frequency curves corresponding to a transfer function with only real poles. 2—Relation of asymptotic and experimental frequency curves corresponding to a zero lying between two poles in frequency. (Location of poles indicated by ×, zeros by ●.) 3—Procedure for finding approximate location of a second order corner point (B) from two single order corner points close together (A and C).

exact db-log frequency curve is the sum of the exact curves of each of the components. Hence the total or net correction representing the difference between the over-all exact curve and the over-all asymptotic curve will equal the sum of the correction curves for each of the components.[6] Our aim has been, therefore, to find a way of determining the total correction curve (or appropriate points on it), and to subtract it from the experimentally obtained exact frequency curve. This procedure, if accurate, will lead to the asymptotic curve and thus reveal, by way of the corner points, the values of the time constants of the system.

To illustrate the procedure in detail, let us consider the frequency response curve that corresponds to a transfer function with only real poles. That is to say, the factors of the transfer function are all assumed to lie in the denominator, and there are no quadratics. The frequency response curve of this function will show a continually

[5] The asymptotic curve for any single time-constant factor consists of only two straight lines, one asymptotic to the low ω end and the other to the high ω end of the exact curve. The term *asymptotic* is retained for the over-all curve obtained by taking the sum of the component curves, even though, in the over-all curve, only the first and last segments are asymptotic to the over-all exact curve.

[6] This correction curve is the same for all time-constant factors if the correction is taken as a function of ωT_k, where T_k is any time constant.

increasing slope, as in curve E of Fig. 1. Let us suppose that this curve, plotted ω db-log on scales, has been experimentally determined, and our problem is to determine the transfer function to which it corresponds. Such an experimental curve, equivalent to the "exact" curves of our previous discussion, is not made up of straight line segments and shows no directly perceptible features that identify the factors of the transfer function. If, however, we can derive from it the corresponding asymptotic curve, the corner points of the latter and the slopes of adjacent segments will provide us with the necessary information.

The procedure proposed may be regarded as a graphical method of successive approximation, carried out in a series of stages. As a preliminary step, the asymptotes are drawn to the low and high ω ends of the curve, using straight lines with slopes that are some multiple of 6 db per octave. At the low ω end this is likely to be a line with a slope equal to zero or – 6 per octave. The first step of stage one consists in finding a trial set of corner points. As a basis, it is assumed that the db correction (ε) at each corner point will be 3 db. This assumption represents a limiting condition, and is accurate only for a single time-constant factor or for transfer functions with widely separated corner points (e.g., at intervals greater than about 3 octaves). The assumption is useful, however, as a starting point in the series of successive approximations.

To locate the corner points, a pair of dividers is set at the 3-db separation, and moved along the low frequency asymptote, toward the higher frequencies, until the point on this line is found which is 3 db distant, along an ordinate, from the experimental curve. This point is the first trial corner point. A second straight line is drawn from this point, with an increment in slope of – 6 db per octave. The first point on this line that differs from the exact curve by 3 db gives the second corner point. The procedure is continued until one of the straight line segments intersects the high frequency asymptote, giving the final corner point. The total number of corner points associated with the curve should be equal to or greater than the difference between the slopes of the final and initial asymptotes, measured in db per octave, and divided by 6. (In a frequency curve with inflections, there are an additional number of corners equal at least to number of inflections.) It is frequently more effective, in locating the corner points, to work alternately from the low and high ω ends until an intersection of straight line segments occurs in about the middle of the frequency range.

This initial set of corner points provides an approximation to the density of the correct distribution of corner points. This initial set can now be used as a basis for obtaining a more accurate estimate of the db correction at each of the corners. This computation is carried out in the standard way described for the direct db-log frequency method, and indicated above (*2*, *7*, *8*). A table giving corrections for various values of $\omega/1/T$ or ωT can be used to accelerate the process.

The second stage of the approximation can now be carried out in a manner similar to that described. A second set of trial corner points is determined by using as db corrections (in the locating of successive corners) the values just computed instead of the initially assumed 3-db values. This new distribution of corner points is then used in the calculation of a second set of correction values. The procedure can be repeated until the shifts in location of the corner points with each new stage becomes less than some previously established criterion. A more basic test can be made by using the direct method to plot an exact "theoretical" curve from the final set of corner points, and comparing this theoretical curve with the experimentally given curve. If the agreement between the two is not considered satisfactory, the inverse process of successive approximation can be carried further.

The procedure described was adapted to a frequency curve with a progressively increasing slope up to the final asymptote. The result will be a transfer function containing only single order factors in the denominator. Some adjustment in procedure is needed for curves that may differ from this pattern. These modifications can be described briefly by reference to the factors in the transfer function to which they correspond.

In considering the significance of factors in the numerator of transfer functions, the following terms used in complex function theory will be found convenient. The zeros of a function are the roots of the factors in the numerator; the poles are the roots of factors in the denominator. A transfer function with a zero intermediate in frequency between that of two poles will be represented by a frequency diagram such as that of Fig. 2. Corresponding to a zero represented at ω equal to $1/T_2$ there is a reversal in the sign of the increment in slope of the following segment; corresponding to a pole at ω equal to $1/T_3$ there is another reversal in the sign of the slope increment. At frequencies just below those at which these reversals in sign take place, we note that the exact curve intersects the asymptotic curve. This relationship suggests the following rule for incorporation in the inverse method. Whenever a given segment of the trial asymptotic curve crosses the experimental curve, the following segment should be drawn with a reversal in the sign of the slope increment of 6 db per octave. The effect of the rule is to keep the asymptotic curve from deviating too far from the experimental curve.

The possibility of higher order factors is most easily handled by regarding each such factor as equivalent to a product of the appropriate number of single order factors. The presence of such higher order factors will therefore tend to give rise, in the inverse method, to the determination of corner points very close together. If this situation occurs, one may try the effect of substituting a second order or double corner point, as at B, for two single order corner points, as at A and C of Fig. 3. The manner of locating B by extending the previously found straight line segments until they intersect at B is indicated by the figure. The substitution of B for A and C eliminates segment AC as part of the asymptotic curve and implies a second-degree factor in the transfer function in place of two single-degree factors. The final

test of whether the substitution is desirable will be the agreement obtained between the original experimental frequency curve and the theoretical frequency curve corresponding to a given set of corner points.

Finally, a word must be added concerning the procedure necessary for handling possible quadratic factors in the transfer function. A fuller discussion of means for experimentally detecting such factors in the experimental system is reserved for a later paper. One possible approach may be indicated. The presence of a quadratic factor can be detected by observing or recording the transient response of a given system to a step function. Quadratic factors, corresponding to conjugate complex roots, reveal themselves in the transient by damped oscillations. If these can be measured with sufficient accuracy, the damping ratio ζ, and the time constant T_q, can be identified (*2*, *7*, *8*). The specific db-log frequency curve corresponding to a quadratic with the given ζ and T_q can then be determined by computation, or taken from a chart of nondimensional quadratic frequency curves (*7*). The total curve corresponding to the quadratic can then be subtracted graphically from the over-all frequency response curve, leaving a residual curve devoid of the influence of quadratic factors. The inverse method described above may then be applied.[7]

Once the asymptotic curve has been determined, the process of writing the corresponding transfer function is relatively simple. The frequencies of the various corner points are written along the ω axis in the form $1/T_k$. One now proceeds from the low frequency end of the graph, writing down factors to correspond to successive segments. An initial segment at a slope of 6 m db per octave implies a $(j\omega)$ factor with an exponent equal to m. It is located in the denominator if the slope is negative and in the numerator if it is positive. A time constant factor $(j\omega T_k+1)^n$ is written for each successive corner point, with the appropriate value of T inserted in the factor. The degree of the factor equals n, where the increment in slope of the segment following the corner point is $6n$ db per octave. If the increment in slope is negative, the factor goes into the denominator; if positive it goes into the numerator. In case a quadratic wave-form has been initially subtracted from any part of the experimental frequency curve, a corresponding factor, $(j^2\omega^2T_q^2+j\omega 2\zeta T_q+1)$, is inserted in the transfer function, with numerical values for T_q and ζ. A function constructed in the manner described represents the frequency-dependent part of the total transfer function, and may be designated as the function $G(j\omega)$, in the terminology of servotheory. It can be converted into the more general function $G(s)$ by substituting the complex variable s for $j\omega$ in all factors of the transfer function (*4*, *6*, *8*).

[7] A general estimate of the accuracy attainable with the inverse method, for all types of experimental frequency curves, is not as yet available. For the frequency curves with which it has been tried thus far, curves corresponding to transfer functions with four or five poles and zeros, it was found possible to determine correctly the number and location of factors, in numerator or denominator, and the frequency coordinate of the corner points, with errors of the order of 10% after three or four stages of approximation.

The magnitude of the constant gain coefficient K can be determined by inspection of the initial (low ω) segment of the asymptotic curve (*7*, *8*). Its height above the zero db axis (given in db units, and converted into units of gain), at ω equal to one, gives the value of K. The final transfer function, $KG(s)$, thus derived from the experimentally given frequency curve, will be in factored, nondimensional form. From this form it can be readily converted to nonfactored form by multiplying out the various factors; and can then be reformulated as a differential equation (*8*, p. 238). In either form, it can serve as a compact representation of the system, and as a basis for predicting its response to any arbitrary disturbance.

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Some New Finds of Fossil Ganoids in the Virginia Triassic[1]

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In the course of an extensive study of the carbonaceous and bituminous sediments of the Triassic basins in Virginia, a number of heretofore unrecorded fossil fish localities were discovered and investigated.

In October 1942 Martin examined a fresh roadcut along State Route 55 near Thoroughfare Gap in Prince William County and discovered a heretofore unknown or unmapped extension of the nearest Triassic basin (*1*). Along the base of the cut the imprint of a ganoid about 6 in. long, including most of the head and forward fins, was found in an exposure of very soft and

[1] The authors are indebted to David Dunkle and Frank L. Hess for their valuable assistance in preparing the manuscript for publication and to Edward Wagstaff for aid in field surveys.

[2] Formerly with U. S. National Bureau of Standards.

[3] Now with the U. S. National Bureau of Standards Field Service, Sterling, Virginia.

moist, finely laminated, buff siltstone. The site was again visited a year later, and a complete impression of Semionotus was obtained. The discovery was brought to the attention of Dr. David Dunkle, associate curator of the Division of Vertebrate Paleontology of the Smithsonian Institution, who secured permission from the state government of Virginia to excavate the outcrop. A number of ganoids previously unknown to this area were discovered, some exhibiting important variations from species found elsewhere in the Newark System.

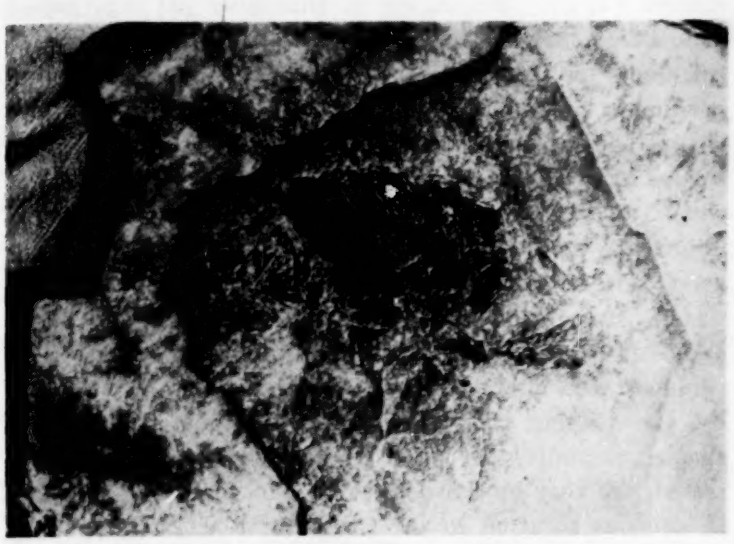

FIG. 1.

On March 6, 1949, further investigation in this district by Edward Wagstaff revealed a small exposure of a highly fossiliferous, dark-gray calcareous shale in the bed of Cotletts Branch, a small brook tributary to Broad Run. The exposure lies roughly one-fourth of a mile northeast of the roadcut. The shale is carbonaceous, very fissile, and considerably indurated. It yielded more distinct imprints and some well-preserved, more or less complete aggregates of scales, fins, and heads. Many of the components of the aggregates appear to be in their original form and proper relationships. The scales are highly polished and jet-black, presenting a marked contrast to the lighter-colored shale.

On July 4, 1946, in a search for agate (*2*), the float along Licking Run in Fauquier County was checked over a considerable distance. About one-quarter of a mile west of a narrow diabase dike a small fragment of dark, carbonaceous shaley limestone bearing jet-black, polished fish scales was found on a dry bar. On April 24, 1949, two years after the abnormally hard freezing and high waters of the winter of 1946–47, many more shale fragments containing fish remains, including one whole fish, were found on the same bar. Black rhombic scales and other parts of various fishes in an excellent state of preservation were fossilized in a dark, very fissile shale similar to that of the Cotletts Branch exposure, but much less indurated and more friable. Intermingled fragments of a coarsely laminated semicrystalline limestone also contained imprints. Some of the fossils were by far the best preserved of all fish found in the Potomac area up to this date. In the float, a large slab showed a nearly intact specimen of Redfieldius, about 9 in. long, with a beautiful mosaic of the scales and harder parts of the fins and head (Fig. 1).

Dr. Dunkle was informed of the discovery and accompanied Baer to Licking Run on May 7, 1949. The outcrop proved to be a veritable mine of fossil ganoids.

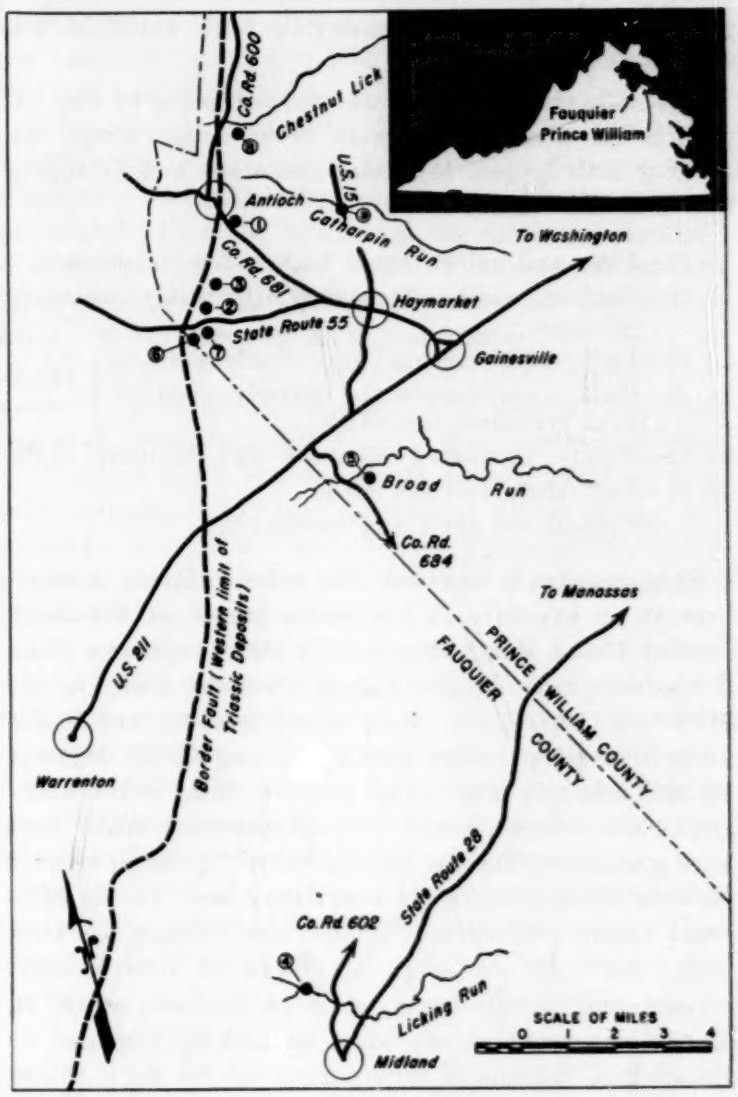

FIG. 2. Sketch map indicating approximate locations of the exposed fossiliferous shales. 1—Exposure in roadcut near Antioch. 2—Siltstone exposure in roadcut on State Route 55. 3—Cottletts Branch. 4—Licking Run location. 5—Broad Run location. 6—Millbrook Quarry. 7—Exposure in small stream near Millbrook Quarry. 8—Chestnut Lick exposure. 9—Exposure in excavation for bridge abutment. 5 ft below surface on U. S. Route 15.

NOTE: The U. S. National Museum has priority at the present time to remove material from the indicated fossil beds. Others must obtain permission to disturb the exposures.

The run was practically at the same stage of flood as on April 24, 1949, but warm enough by this time to permit comfortable wading. An extensive exposure of the fossiliferous shales, entirely submerged in midstream, was easily quarried by hand. Some of the softer layers appeared to be literally soaked with greasy bitumens, and in these the highest concentration of fossils was found, including most of the best preserved specimens.[4]

[4] Nodular lensiform masses, 3–5 in. long, were occasionally observed in the semicrystalline facies of the fossil beds. All specimens examined contained nuclei of nearly complete fossil fish.

About 30 pounds of fossiliferous slabs and fragments were selected and carried to the U. S. National Museum. Specimens of Catopteridae and Ptycholepis were particularly abundant. One large and very interesting impression was later classified as *Diplurus*. Small nodules, possibly coprolites of Triassic reptiles replaced by a phosphoric, carbonaceous material, were much in evidence (*2*).

The following approximate measurements of the exposures on Licking Run were taken under water, beginning with typical Manassas sandstone and extending into Bull Run shale:

8 ft—Pink and yellow shale with a few sandstones.
3 ft—Compact shale, alternating with thinly laminated siltstone.
1½ ft—Dark, carbonaceous, very fissile shale.
½ ft—Dark, carbonaceous, coarsely bedded semicrystalline limestone. } Fossil beds
3½ ft—Thinly laminated siltstone and compact shale.
10 ft—Buff shale and sandstone.
..... —Typical red shale and sandstone.

This sequence is repeated with some variation in thickness at an exposure on the south branch of the south fork of Broad Run. However, in other exposures along a roadway near Antioch, along Chestnut Lick, in the Millbrook Quarry, in a small stream near by, and in the excavation for a bridge abutment along U. S. Highway 15 at Catharpin Run (Fig. 2), the basal sedimentary strata are concealed and the carbonaceous fossil beds have greater thicknesses (5 ft or more), grading upward into the typical red shale and sandstone. In the Millbrook Quarry, where considerable core drilling has been done, the dark shales grade downward into a dark, arkosic conglomerate having a known thickness of 180 ft. The two easternmost exposures on Licking Run and on Broad Run indicate a thinning-out of the dark shales, and farther eastward the chances of encountering the fossil beds seem small.

Wherever scales occur *in situ*, it is probable that more or less complete preservations of fish exist near by. Therefore, it seems safe to assume that fossil fish may be found in a belt at least 18 miles long and approximately 2½ miles wide near the western Triassic border adjacent to the Bull Run Mountains, where scales are found in numerous exposures at well-spaced intervals. The discoveries outlined in this paper, not to mention the additional collecting possibilities in the entire fossiliferous belt, are significant if only because no ganoid fossils other than isolated scales have, to the knowledge of the authors, been recorded heretofore from the Triassic basins of northern Virginia. Furthermore, the character of the occurrence in siltstone near Thoroughfare Gap appears to be unique in the history of the Newark System.

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Colchicine Poisoning in Relation to Hemerocallis and Some Other Plants

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Colchicum species contain appreciable amounts of colchicine (*4*, *5*). According to Blakeslee (*1*) and Levan (*3*), *Colchicum* species they tested were not subject to colchicine poisoning under the conditions of their experiments.

On the basis of these reports, it would seem logical to assume that plants, other than *Colchicum* species, which also contain appreciable amounts of colchicine, might likewise be immune to colchicine poisoning. However, this hypothesis apparently has not as yet been tested. According to Klein and Pollauf (*2*), the presence of colchicine in *Hemerocallis fulva* L. has been demonstrated microchemically; but extensive experiments by the present writer have shown that *Hemerocallis* species, including *H. fulva* L., and various hybrid clones tested, are very sensitive to colchicine, and concentrations in aqueous solution in the range from 0.025% to 0.1%, tested with appropriate application techniques, proved to be quite effective in inducing polyploidy. Concentrations much above 0.1% usually led to the eventual death of the treated plants.

A number of colchicine-induced *Hemerocallis* polyploids have flowered. Their polyploid nature was established on the basis of chromosome counts, and pollen grain and stomate size. One polyploid, Tetra Starzynski, $n = 22$, a tetraploid of the clone Mayor Starzynski, $n = 11$, has been named. Its flowers are larger and finer-colored than those of the diploid form. This removes all doubt about the effectiveness of this compound as a mutagen in this genus. The object of the present note is not to elaborate here on these results, which will be reported in detail elsewhere, but rather to consider very briefly their implication, particularly with reference to the validity of the microchemical method used for determining colchicine.

Klein & Pollauf (*2*) used a microchemical procedure for the determination of colchicine in *Hemerocallis fulva* L. In view of the marked sensitivity to this compound of *Hemerocallis* species, including *H. fulva* L. and hybrid clones, their results require verification. If their report can be verified, then it would appear, in this instance at least, that plants which contain relatively smaller amounts of colchicine could be affected by the application of relatively larger amounts of the compound. It is also desirable to check the reported colchicine content of species in other genera. In this connection, it is of interest to note that *Gloriosa rothschildiana* O'Brien (a plant closely related to *G. superba* L., which is reported to contain colchicine) is subject to colchicine poisoning in the range tested, 0.05%–0.2% concentrations, particularly in the case of small seedling tubers.

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Preparation of a Radioactive Oxazine Dye[1]

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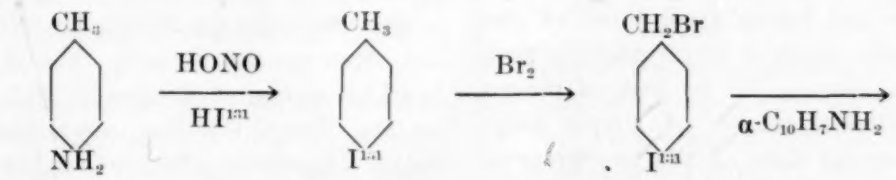
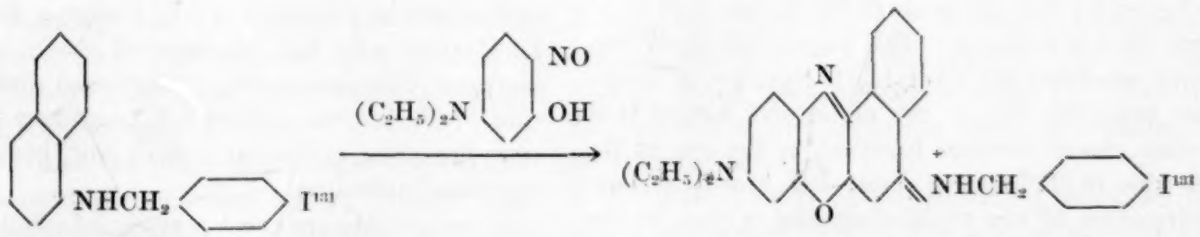
The discovery (*2*) that the oxazine dye Nile blue A stains and retards the growth of malignant tumors in mice stimulated the investigation of related compounds. Of the oxazine dyes tested on mouse tumors (*1*), the one known as Nile blue 2B, Colour Index No. 914 (*5*), showed the greatest affinity for tumor tissue. The halogen derivatives of Nile blue 2B have been prepared (*3*) with the intent of using one of them as a "carrier" of radioactivity to the tumor tissue when radioactive halogen is present in the molecule. It is the purpose of the present paper to describe the preparation of the radioactive iodine derivative of Nile blue 2B.

The synthesis of this radioiodo dye was carried out (without isolation of intermediate compounds) by the following series of reactions:



p-toluidine — *p*-radioiodotoluene — *p*-radioiodobenzylbromide



N-(*p*-radioiodobenzyl)-α-naphthylamine

5-(*p*-radioiodobenzylamino)-9-diethylaminobenzo[a]phenoxazine

A solution of 3.3 g of *p*-toluidine in 35 ml of water and 3.6 ml of concentrated sulfuric acid was carefully diazotized at 5° C with 2.1 g of sodium nitrite in 20 ml of water. To 18.5 mc of carrier-free I^{131} [2] in 15 ml of water, was added 5 g of potassium iodide and this solution was slowly added to the cold diazotized solution. A small quantity of sodium sulfite was added to reduce any iodine. The mixture was kept in an ice bath for 30 min, then at room temperature for 1 hr, and then heated gently on a steam bath for 1 hr. The resulting mixture was then steam-distilled until 250 ml of distillate was obtained. The distillate was made decidedly alkaline with sodium hydroxide solution, a small amount of sodium sulfite was added to it, and then it was extracted with 150 ml of carbon tetrachloride.

This solution of *p*-radioiodotoluene in carbon tetrachloride was washed three times with water and then evaporated to a volume of about 50 ml. To this solution was added 1.55 ml of bromine in 25 ml of carbon tetrachloride, and the reaction flask was attached to an efficient all-glass reflux condenser. The flask was illuminated by two 200-w clear Mazda lamps, and heated at gentle reflux for 3 hr, at which time the evolution of hydrogen bromide had ceased. The mixture was then cooled to room temperature and 5 g of potassium iodide in 25 ml of water was added. Sodium thiosulfate solution (approx. *N*/10) was then added till all iodine was reduced. The carbon tetrachloride layer was separated and washed with water. The carbon tetrachloride was distilled off on a steam bath.

The resulting *p*-radioiodobenzyl bromide was dissolved in 50 ml of ethanol and to this was added a solution of 12 g of α-naphthylamine in 50 ml of ethanol. The mixture was heated in a water bath under reflux condenser for 2 hr. The ethanol was distilled off and the residue extracted three times with 100-ml portions of 1: 50 hydrochloric acid to remove excess α-naphthylamine.

The resulting N-(*p*-radioiodobenzyl)-α-naphthylamine (containing a small quantity of α-naphthylamine) was dissolved in 75 ml of ethanol and 9 ml of concentrated hydrochloric acid. To this was added a solution of 10 g of 2-nitroso-5-diethylaminophenol in 25 ml of ethanol. The mixture was gently boiled under reflux condenser for 3 hr and then allowed to stand overnight. After cooling in an ice bath for 1 hr, the product was filtered and washed with cold ethanol and then with ether. The weight of product obtained was 8 g.

Radioactivity of the dye was measured, using a thick-window, cylindrical, gamma-ray Geiger-Müller tube. An

[1] Aided in part by a grant to Dr. Margaret R. Lewis from the National Cancer Institute.

[2] Obtained from Oak Ridge National Laboratory.

accurately weighed sample of the dye was dissolved in ethanol (about 0.1 g per 100 ml) and a 0.50-ml aliquot was placed on a 1-in. square of filter paper. As soon as the ethanol had evaporated, the paper square was placed between gummed paper labels. This was placed in direct contact with the Geiger-Müller tube with a tight rubber band. The Geiger-Müller tube was calibrated by counting in identical fashion an aliquot of the original I^{131} solution which had been assayed at the Oak Ridge National Laboratory. The activity of the dye, measured in this manner, was 0.55 mc/g.[3]

This radioactive dye has been administered to tumor-bearing experimental animals and to a small number of human subjects. Results appear elsewhere (*4*).

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Occurrence and Life Histories of Commercial Shrimp

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Grooved shrimp (*Penaeus*, Division II) are unusually prominent in the North Carolina catch. Study of the species has been impeded not only by lack of means to distinguish them from each other before adolescence (or to distinguish their eggs and larvae from those of the ungrooved *P. setiferus*, with which it seems possible that Pearson (*3*) has confused them), but by lack of means for rapid field identification of adults. A simple diagnostic test for the commercial sizes of the two grooved species common in continental North America is that *Penaeus duorarum* Burkenroad, the spotted shrimp, bears a reddish brown midlateral patch at the juncture of third with fourth pleonic segment. This pigmented spot, first called to my attention by Captain O. Purifoy, is larger and denser than the one at the midlateral hinges that lock the other pleonic somites together, or the one at the equivalent site in *P. aztecus* Ives, the brown shrimp. Field confirmation of the rapid diagnosis is seen in the difference between the common North American forms of these two species in width of groove alongside the mid-dorsal carina of sixth pleonic segment (*1*).

No special fishery for spotted shrimp has previously been described. A 10-year-old one in the shallow Straits between Core Sound and Beaufort Inlet, North Carolina, employs some seventy channel nets, like boardless, long-winged otter trawls, which are staked or anchored in strong tide-currents during night ebb in May, June, and July. These stationary tide traps intercept shrimp swimming off the bottom (presumably migrating to sea). A catch of over a ton by one 75-ft net on one ebb has been reported, but the annual production of the whole fishery is probably around 100 tons. The catch, especially prized for hardness, sometimes contains a proportion of brown shrimp but is chiefly immature *P. duorarum*. Since grooved shrimp in the North Carolina commercial trawl catch are mostly *P. aztecus*, the tide traps evidently select the spotted species from an inshore and inside grooved shrimp population which is as a whole preponderantly of brown shrimp. There is evidence, however, that young spotted shrimp are in the majority on the shallowest bottoms of the saltier sounds.

During the last decade, the proportion of grooved shrimp in the annual North Carolina catch has probably fluctuated between a third and a half. Brown shrimp have always been prominent in the catch of Carteret County, but testimony from fishermen suggests that since 1936 these shrimp have become absolutely, as well as relatively, more abundant not only there but on the grounds farther south around Cape Fear, which before 1936 supplied a larger share of the state's catch, including a higher proportion of the gray shrimp, *P. setiferus*. Since there are indications of unusual abundance of *P. aztecus* during the same period along its whole Atlantic Coast range, it seems possible that the population of this species has undergone a recent increase. Such an increase may have contributed to the development since 1936 of an extensive new fishery in Pamlico Sound. This, the most northern American market fishery for peneid shrimp, sometimes supplies more than a third of North Carolina's production, chiefly from a summer run of relatively large brown shrimp.

Brown shrimp in North Carolina shoal-water catches are often nearer maturity than is usual along the more brackish shores of Louisiana, but the spawning grounds of the North Carolina population have not yet been found. Sporadic offshore catches of jumbo shrimp by winter fish trawlers in the Hatteras-Lookout area are chiefly of gray and of spotted shrimp; and a reliable and widely experienced North Carolina fleet owner, Mr. L. Hardee, who has encountered the abundant, though scattered, orange-colored, yellow-roed breeding population of *P. aztecus* present off Louisiana in 15–70 fathoms the year round (*1*), does not know of a North Carolina equivalent.

Although this apparent scarcity of adult brown shrimp off North Carolina may simply reflect the inadequacy of exploration, it is not necessarily inconsistent with the high density of the state's inshore immature population. Half-grown brown shrimp appearing in New Jersey in midsummer are evidently postlarval immigrants (*1*). It is therefore conceivable that North Carolina brown shrimp, in contrast to the endemic spotted kind, chiefly originate farther south.

It should be observed that, as long as the Atlantic habitat of mature brown shrimp remains unknown, the belief that there is no extensive Atlantic deepwater population of gray shrimp (*4*) cannot be regarded as

[1] Private laboratory: Ecos, Bogue Sound Road, Newport, North Carolina.

[3] Miss Ruth E. Brown assisted with the radioactivity measurements.

unquestionable. There is also some basis for questioning the related belief (*2*) that *P. setiferus* normally dies after only one or two spawnings, and without surviving a second winter; since the gray shrimp, like the brown, continues to molt after beginning to spawn; and since a large proportion of adult females, including many nearly ready to spawn again, already show traces of previous spawning in early spring.

King's suggestion (*2*) that nature has failed to make "proper provision for the egress" of the eggs of *P. setiferus*, evidently results from failure to detect ripe eggs left behind in the spawned ovary except when retention was abnormally great. Normally, there is only a sparse scattering of leftover ripe eggs (*1*). For example, among a sample of 67 unripe and ripening hard-shelled North Carolina May adults, most or all of which had spawned previously, such eggs could be detected in 26 by teasing 0.1 ml ovarian samples. The average number of leftover eggs per positive sample was less than two, and the maximum ten.

Remains of spermatophores attached to female gray shrimp offer a second clue to previous spawning. These remains are of two distinguishable types: glutinous remnants grading up to large fragments, and found only in some of the very ripe, which are evidently from recent spermatophores accidentally torn away before spawning; hard traces, never conspicuous, and least frequently detectable in ripe individuals, which are evidently left after normal spermatophore dissolution at spawning. In a sample of 99 unripe and ripening hard-shelled females from the same catch as and including the 67 examined for leftover eggs, 82 bore recognizable spermatophore traces. Since those lacking spermatophore traces bore leftover eggs in about the same percentage as did the whole sample, and vice versa, it appears that even among those not displaying either indicator, most or all had spawned before.

Among very ripe females of the same catch, minute spermatophore traces were detectable in 15 of 31 closely examined. The catch (trawled near shore at Cape Fear in late May, 1949, by Mr. Carter Broad of the Institute of Fisheries Research) included a total of some 130 very ripe, 160 ripening, and 120 unripe adult females. None of this particular catch seemed newly mated or newly spawned. Seven, all unripe, were soft-shelled; of which three had leftover eggs.

It will be seen that the previously misinterpreted distribution of spermatophore traces among female gray shrimp from deepwater catches off Louisiana in March (*1*) suggests the presence of survivors of the preceding season's spawning.

Xiphopeneus kroyeri (Heller), sometimes abundant in Louisiana and a prominent commercial shrimp of Brazil, has not been previously reported from North Carolina. Three ripe females of this species occurred with the catch from Cape Fear, just mentioned.

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Periodate Oxidation in the Study of the Structure of Dextrans

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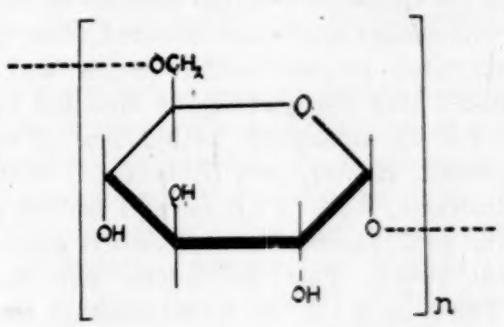
It was predicted by Brown *et al.* (*1*) that pyranoid 1–6 polyglucosans (dextrans) should behave in a distinctive manner toward periodate ion by means of which dextrans may be distinguished from other polysaccharides. Oxidation with potassium *m*-periodate cannot be utilized for the determination of the mean chain length since each 1: 6-glucopyranose residue undergoes oxidation with the liberation of 1 mole of formic acid by virtue of the fact that each such residue possesses hydroxyl groups on three contiguous carbon atoms. Thus, a "straight chain" 1: 6-polyglucose, provided that all the units are pyranose, will behave in a manner analogous to a methyl glucopyranoside as far as the production of formic acid is concerned. It follows that the equivalent weight of such a dextran, i.e., the weight of material yielding 1 mole of acid, will be numerically equal to the equivalent weight of a single glucose residue, viz., 162.



However, any 1–6 glucose residue which is triply linked and thus constitutes a point of branching in the molecule, will not yield formic acid no matter whether the side chain be attached at C_2, C_3, or C_4. (This will also be true for any furanose units or residues linked other than 1: 6-). The presence of numbers of such points of branching will be manifest in an experimental value for the equivalent of a dextran greater than the calculated value. From the difference in these two values it should be possible to determine the ratio of branched residues to straight residues.

A detailed study of the periodate oxidation technique has been carried out by Pacsu *et al.* (*5*) in which the limits of accuracy for the determination of formic acid in the presence of comparatively large amounts of reducing substances have been defined, the best results being obtained by titrating potentiometrically to a given pH. In the case of the dextrans, the total amount of formic acid liberated is considerable (cf. oxidation of starch) and it is not until the end point is reached that interference from other products of oxidation becomes significant; notwithstanding this, the total amount of acid can be determined with considerable accuracy.

[1] Rockefeller Foundation Fellow at Princeton University.

A series of studies were made upon the rate of oxidation, simultaneously and under identical conditions, of α-methyl glucoside, β-methyl gentiobioside, *Leuconostoc mesenteroides* dextran (*7*) and *Leuconostoc dextranicum* dextran (*6*). In all cases the rate of reaction was almost identical and the equivalent for the first two substances agreed closely with the calculated value. *L. mesenteroides* dextran was found to have an equivalent of 204, i.e., 1.25 × theory. Thus from 5 glucose units only four yield formic acid or, in other words, 1 unit in five is engaged in side branching. This evidence indicates a structure:

$$G^1 - {}^6G^1 - {}^6G^1 - {}^6G^1 - {}^6G^1 - \quad (I)$$
$$\quad\quad\quad

Finally, in 1948, guinea pigs were tried, using hexobarbital intraperitoneally as the anesthetic. On awakening, the animals were given glucose, also intraperitoneally. Practically 100% of the guinea pigs responded with a return to sleep after awakening from hexobarbital, when 1 ml of glucose solution was injected intraperitoneally. Rats do not behave in the same way; rabbits and hamsters do, but with more delay in the onset of anesthesia after glucose.

As yet we have not developed an accurate quantitative method for studying this reaction. Guinea pigs were given a dose of hexobarbital intraperitoneally, 0.20–0.25 ml of a 2% solution per 100 g of pig. They went to sleep in about 2 min and slept for about 45 min but varied considerably in time of awakening. When the pig was definitely awake and responded to stimulation, but before it could run around, glucose, or whatever substance was being studied, was given intraperitoneally. The pig usually responded instantly or within 5 min, and went to sleep on its side. It would at first respond slightly to a pinch of the foot by squealing, but more violently if the back of the neck was pinched. After 5 min, there might be no reaction of any sort after pinching the foot or neck. In about 45 min, the pig woke up and often could be put to sleep by a second dose of glucose. If too long a time passed before the second injection was made, there was no response.

At present our best criterion of effect from the injection of a given substance is the return to sleep and anesthesia after awakening from the hypnotic. The duration of sleep is too variable for quantitative work unless large numbers of animals are used. After hexobarbital over 30 pigs have responded to the intraperitoneal injection of 1 ml of 50% glucose and only a rare pig has failed to respond, although the degree of response varies. They have responded well to the injection of 5% glucose in doses of as much as 10 ml in a 500-g pig and as little as 1.25 ml or approximately 12 mg/100 g of pig. The injection of glucose alone causes no sleep or anesthesia.

That this is not an osmotic effect is shown by the fact that solutions of sucrose, as well as of sodium chloride of the same tonicity, do not produce such an effect. We have obtained this reaction to glucose after hexobarbital, narconumal, seconal sodium, and pentothal sodium; but have obtained no such reaction to glucose after ether, chloral, or chloralose. We have found that intermediary products of glucose metabolism such as hexose diphosphate, lactate, pyruvate, succinate, and fumarate, as well as malonate, and the water extract of both brewer's and baker's yeast produce the same effect, some more strongly than glucose. Sucrose, as already stated, produces no such effect; arabinose only a slight effect; and galactose and levulose a definite effect, but less than glucose.

To observe this reaction, inject a guinea pig intraperitoneally with a 2% solution of hexobarbital soluble (0.25 ml/100 g of pig). This will cause sleep for about 45 min to an hour. When the pig wakes up and responds well to pinching, but before it can run, inject 2 ml of 50% sodium lactate (Mallinckrodt) (0.1 ml is effective). This has consistently produced such a pronounced depression that there is no doubt about the result. The same reaction is produced regularly in dogs by lactate, malonate, or succinate.

As far as we are aware, the observations given here have not been reported before, although the literature on the relationship between glucose and its metabolic products to anesthesia is enormous and sometimes conflicting. Our results in dogs show very wide variation in response to glucose after barbiturate anesthesia; the great difference of reaction in animal species might account for this. Our results are qualitative only, excessively large doses having been given at times to insure a reaction of an active substance. The effect of each compound used has, however, been controlled by injection of a corresponding amount of the substance in a normal animal without anesthetic; such injection has in no case produced depression.

After this article had been written, it was found that, although the duration of hexobarbital anesthesia did not seem to be greatly changed by the simultaneous administration of glucose or its degradation products, in the few experiments tried, these substances greatly affected the dose of hexobarbital necessary to produce anesthesia, lowering it roughly from 0.15 ml of 2% hexobarbital solution to 0.01 ml when 2 ml of 50% sodium lactate was given at the same time. The potentiating effect of glucose was striking, but less than that of lactate. Pigs which showed no response to a subanesthetic dose of hexobabital went to sleep at once after the injection of glucose or lactate.

It would therefore appear that we have been dealing with a potentiation of barbiturate anesthesia by glucose and its metabolic degradation products and that the return to a state of hypnosis or anesthesia after waking from barbiturate sleep is probably due to a potentiating effect of these substances on the subanesthetic level of barbiturate in the blood.

Detailed reports of our work will be published later.

Comments and Communications

On the Discovery of the Action of Colchicine on Mitosis in 1889

The description of the effects of colchicine on mitosis by A. P. Dustin (*Bull. Acad. roy. Med. Belg.*, 1934, **14**, 487) and F. Lits (*C. R. Soc. Biol.*, 1934, **115**, 1421) marked the beginning of a period of active investigation. During the next 15 years, publications dealing with this alkaloid averaged about 100 titles per year. The first study of the action of colchicine on mitosis, we now believe, is the one published by B. Pernice (*Sicilia Med.*, 1889, **1**, 265). Several papers since 1934 have credited W. E. Dixon and W. J. Malden (*A manual of pharmacology.* London: Arnold, 1906, and *Physiol.*, 1908, **37**, 50) with the original observations on colchicine mitosis. They mentioned that after repeated injection in mammals, "plentiful mitotic figures can occasionally be observed" in smears of bone marrow. However, they did not give details or illustrations. On the other hand, the figures and text of Pernice make it clear that he observed in considerable detail the cytological action of this drug.

We have been interested in colchicine bibliography (*Lloydia*, 1947, **10**, 65) for the past ten years, and a work now in press (*Lloydia*) includes a reference to this work of Pernice. Through the service afforded by the U. S. Army Surgeon General's Index, and the cooperation of the Library of the U. S. War Department, Washington, D. C., we have been able to study this document. Greater details, as well as presentation of figures, will be published when suitable arrangements can be completed. However, at the moment, certain sentences are so appropriate that a few of Pernice's observations are included, with our comments.

In his paper, entitled: "On the karyokineses of the epithelial and endothelial cells in the mucosa of stomach and intestine, in experimental gastroenteritis following colchicum poisoning," Pernice studied with great care the gastrointestinal mitoses in two dogs given, respectively, 10 and 15 g tincture of bulbs of colchicum, and dying 24 and 48 hr later. In the stomach were to be found "an extraordinary great number of dividing cells." Furthermore, he stated that within the Lieberkühn glands of the intestine, "nearly all cells are engaged in indirect division." Endothelial mitoses can be seen "nearly in all vessels." Moreover, it is "rare to see the latest stages of division." Pernice considered that "the cellular elements may have been directly excited and stimulated by the tincture of colchicum." He noticed that some of the mitotic figures apparently underwent destruction and added: "Perhaps this is a necrosis of the cells, giving rise to some sort of pseudo-karyokinetic forms." H firmly stated, however, the relation of the observed images to true mitosis. The illustrations show gastric and Lieberkühn glands, one with "*quasi tutti gli elementi in cariocinesi,*" and divided equatorial plates, but no true anaphases or telophases are represented.

Pernice deserves due credit for his discovery; thus the action of colchicine on mitosis has been known since 1889. While many physiological studies of the intestine in chochicinized animals were published in the interval from 1889 to 1934, the mitotic abnormalities were not described again until 45 years later. The year 1949 marks the 60th anniversary of the discovery of colchicine mitosis.

O. J. Eigsti, P. Dustin, Jr., and N. Gay-Winn
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A Nomination for the ISCC

My hearty approval of the article on Ridgway's color standards (*Science*, June 17).

You will find that I have been active in the past in an attempt to produce color standards which will be both permanent and reproducible. Inorganic ions and compounds were found to be permanent and could be accurately reproduced from known formulas; ferric chloride and cobalt chloride were the compounds employed. The nickel ion would probably have been the next, had I been able to continue the study.

The American Society for Testing Materials, neighbors of mine on Race Street, Philadelphia, have already done excellent studies on the color problem and know much of its intricacy. They might be the best available organization for the purpose mentioned in Dr. Middleton's letter (*Science*, June 17).

John Pim Carter
Academy of Natural Sciences, Philadelphia

Solar Rotation and Kepler's Laws

H. W. Babcock, of Pasadena, recently announced discovery of some significant correlations between the magnetic fields and the rotation of several astronomical bodies. P. M. S. Blackett, distinguished English physicist, found that Babcock's constant $Q/mr^2\omega$, or magnetic moment/angular momentum, is proportional to $G\hbar/c$, or square root of gravitation constant/velocity of light.

In calculating angular velocity, Prof. Blackett took the sun's equatorial time of rotation, about 25 days. But the sun does not rotate uniformly like a solid sphere and different values are found when the average time of rotation is used (i.e., mean of observed latitudes). This is a little more than 29 days, or about 2,510,000 seconds.

Substituting for m the equivalent term v^2r/G, angular momentum would be given by $v^2r^3\omega/G = 2.4 \times 10^{40}$ in c.g.s. units and $\dfrac{Q}{v^2r^3\omega/G}$ would be $8.9 \times 10^{33}/2.4 \times 10^{40} = 1/2.6 \times 10^{15}$. This would be proportional to $1/G(2\pi c)^{\frac{1}{2}}$ (i.e., approximately $1/2.4 \times 10^{15}$).

One of the factors abstracted from the equations, $r^3\omega$,

or cube of sun's radius multiplied by its angular velocity, is proportional to a Keplerian constant for the solar system, $2\pi rv^2$, or planetary orbit multiplied by the square of orbital velocity, e.g., in cm/s units:

$$2\pi rv^2 = (6.28 \times 6.95 \times 10^{10}) \cdot (4.38 \times 10^7)^2 = 8.37 \times 10^{26}$$
$$r^3\omega = (6.95 \times 10^{10})^3 \cdot (6.28/2{,}510{,}000) = 8.4 \times 10^{26}$$

This equivalence suggests that planetary motions are related to the sun's rotation and regulated by electromagnetic laws, as Kepler surmised.

CORNELIUS O'CONNOR

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Corneal Contact Lens Reference?

It has been widely quoted that Sir John Herschell was the first to suggest the possibility of making a corneal contact lens. Can any of your readers give us the exact reference in Sir John's writings regarding this idea?

KATHERINE FERGUSON CHALKLEY

Manuscript Editor
American Journal of Ophthalmology,
Lake Geneva, Wisconsin

Guarded Circuit Bridge

A precision guard circuit has been constructed to operate in conjunction with a Modified Schering Bridge so that three terminal guarded measurements can be made on solid and liquid dielectrics over the operating frequency range of the bridge; namely, 100 cycles/sec to 300,000 cycles/sec.

The detector system used with this equipment is made up of a matching amplifier with built-in selective frequency filters between the output of the bridge and main amplifier. The main amplifier has a flat frequency response of 40 db from 60 cycles/sec to 1,000,000 cycles/sec. The output of the main amplifier is fed to one set of plates of a standard oscilloscope. The other 'scope plates are fed directly from the bridge supply oscillator through a phase shifter.

Amplifiers are operated at full gain with the signal forming an ellipse on the 'scope screen. Controls are adjusted so that resistance balance opens and closes the ellipse and capacity balance tips the closed line right or left from horizontal.

Accurate balance is obtained over the complete frequency range of the bridge.

The guarded circuit bridge enables one to make dielectric constant and dielectric loss measurements under controlled humidity conditions and at different temperatures, which are impossible with a two-electrode system. Surface leakage on a dielectric cannot be separated from volume resistance using an unguarded bridge. Edge corrections for electrostatic fringing are also eliminated by means of the guarded test electrode.

STANLEY I. REYNOLDS

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Report from Sweden

The more important scientific activities of the Scandinavian countries are known in this country by way of the Scandinavian journals and abstracts in our own American medical journals. Therefore, when I went to Stockholm to visit the larger hospitals and state and municipal laboratories, I did so with a good many preconceived ideas and the feeling of at least a surface familiarity with the work in progress. I found, however, a laboratory organization quite different from that in the U. S., owing to some extent, to the absence of large commercial pharmaceutical plants and also to the semi-socialization of medicine in this country.

In this account I shall not attempt to give a complete picture of all the important laboratory activities in progress. My visits were confined almost exclusively to Stockholm. However, I was assured that the organization here is prevalent throughout Sweden.

Swedish laboratory medicine is now centralized to a large extent. In recent years demands for decentralization have increased, and to some degree plans for this process have been made and will be carried out within the next decade or two. Stockholm (and all the larger communities in Sweden) maintains one central municipal bacteriological laboratory that works with and for all the city hospitals except the Medical Institute—Karolinska Hospital—which is to a large degree self-sufficient. Individual hospitals maintain small bacteriological laboratories to do a few routine tests, but send most clinical diagnostic work to the municipal laboratories. But all the hospitals maintain adequate chemical, hematological and pathological laboratories.

The Municipal Bacteriological Institute is rather inadequately housed in an old converted school house, but plans for new quarters have been drawn up by the directing head, Prof. Davide. Funds are available and it is hoped that in three or four years the new quarters will be ready for use. The plans call for a continuation of the present organization into four scientific departments: clinical bacteriology, i.e., cultures and antibiotic tests; serology, including Wassermann and Widal tests, antistreptolysin titers, and staphylococcal lysin titers; intestinal infection; and tuberculosis. To this will be added a fifth and very important section—a virus department in which Prof. Davide tentatively plans an emphasis on encephalitis investigations.

Opportunities for research in the present cramped quarters are of necessity restricted. In the new building, however, adequate space for research is planned for, so that each department head will have a small laboratory for private scientific investigations. Prof. Davide is continuing his extensive 15-year work on bacterial metabolic products with bactericidal action on *Mycobacterium* tuberculosis. His associate, Dr. Pakalin, is also continuing with his work on the effect of generalized infections on the clinical course of tuberculosis. Both men were most kind in showing me their work, as were their staff, and the staffs in all the institutions I visited. English is generally spoken, usually very fluently, and older doctors speak excellent German.

No teaching is done at the municipal institute, but in the new quarters provisions are made for teaching clinical bacteriology to medical students. The staff consists of six doctors and about 20 technicians. The professional staff here and at the hospitals is predominantly male. I was assured constantly that the dearth of woman physicians merely reflected the fact that here women prefer a home and husband to a medical career. The technicians, on the other hand, are exclusively female. Incidentally, the status of the Swedish laboratory technician is considerably different from that of her American counterpart. She is not college-trained, but is given special training for a period of eight months to a year, to qualify her for routine laboratory work. All diagnostic results are supervised, checked, and officially reported by a member of the staff holding a university degree. This state of affairs is becoming more and more deplored by the laboratory directors, and there has been considerable agitation for more adequate scientific training of technicians.

I visited several of the hospitals of Stockholm. Two of these, Sabbatsberg (where the new municipal center will be housed) and St. Eriks, are good examples of the average city hospital. Both of these maintain only very small bacteriological laboratories, using the municipal center for almost all of their bacteriology, but maintain all the clinical laboratory divisions in adequate form. At Sabbatsberg, where the hospital is quite old but the laboratory quarters are housed in a new and extremely modern building, the main research problems are pathological, initiated by the director, Prof. Bergstrand, and concern morphological and biochemical analysis on changes in liver and kidney diseases. The equipment here, as indeed in all the laboratories except the municipal one, which will be completely reequipped, is astonishingly modern and considerably more than adequate. Binocular microscopes, usually of German, Swiss, or English make, are used exclusively. Large built-in, stainless steel autoclaves are found everywhere; stainless-steel centrifuges holding 24 tubes are of Swedish make and, I am told, excellent. There is usually no difficulty in obtaining the standard laboratory equipment. Libraries are, by American standards, inadequate. Each institute usually has only a small library of journals and books pertaining to its own medical specialty. However, the Karolinska Medical Library is excellent, fully equipped not only with American and central European works but also with a good selection from eastern Europe. This library is available to all the other medical institutions of Stockholm.

At St. Eriks Hospital, where Dr. Josephson was most kind in showing me his equipment, I was again impressed by the excellent laboratories in a comparatively old hospital. Here, as in all the other hospitals, there is a workroom with trained mechanics who can manufacture a good deal of the equipment. Dr. Josephson is working on the excretion and tubular function of kidney metabolism and plans to publish his results in a new English-language journal, the *Scandinavian Journal of Clinical and Laboratory Investigations.* I asked him about the effects of the semisocialization of Swedish medicine on research, and he assured me that, although he gets his funds from the Swedish State Medical Council, there is no state control of research at all, either in his own or in any of the other institutions.

One of the oldest hospitals in the city is the institution for epidemic diseases, aptly called Epidemi Hospital. Here again there are plans ready for a whole group of new buildings, especially a large central laboratory department, with adequate bacteriological and virus quarters. Dr. Hedlund, who is one of the consulting physicians there and in charge of the bacteriology laboratories, emphasized the fact that he and the other staff physicians will have adequate quarters in the new building for private research. He is engaged in serological studies on polyarthritis and hopes to continue along these lines. Like all the physicians I spoke to, he expressed the greatest interest in the U.S. All without exception either have visited our country in the past or hope to do so soon.

The show piece of Stockholm medical circles is Söders Hospital, a new ultramodern institution. Here the planned decentralization of laboratories has to a great extent become a reality. There are large individual laboratories where all the necessary tests can be carried out so that very little is sent to the municipal center. The work here is mostly routine diagnosis, and very little research has been done so far.

The Swedish State Bacteriological Institute is one of the most modern laboratory establishments to be found in Sweden. Opened about 12 years ago it is independent of the Swedish Medical Board and stands directly under the public health authorities. Its functions are both diagnosis and research.

The institute is headed by Prof. Olin, whose work, especially the *Salmonella* phase of it, is familiar to Americans. The permanent staff—about 25 professional persons and 200 technicians—is distributed among a diagnostic department, a virus department, a division for chemical bacteriology, an antibiotic division, and a department for the production of vaccines and serums. The latter produces most of the vaccines and sera used in middle and central Sweden. Only smallpox vaccination is compulsory, but diphtheria vaccination is available free of charge to all school children.

The equipment of the institute is modern and complete. Microscopes are exclusively binocular, of German and Swiss make; Swedish centrifuges, electrofreezers, and autoclaves are excellent and the customary workshop in the cellar can produce a large percentage of the laboratory equipment. Karolinska's library is used extensively but there is a fair stock of current journals of the bacteriological field in the institute. The electron microscopes at Karolinska are available for research, as is also the one at Uppsala. Here, as everywhere, plans are being completed for new buildings, especially for enlarging the virus department and facilitating more work on polio and hepatitis.

When the State Institute was built provision was made for each doctor to have adequate space for research. Since most members of the staff are affiliated as consultants with one or more of the city hospitals, coopera-

tion and interchange of information are excellent. All the departments carry on research, to a large extent in connection with their diagnostic routine work.

So far as medical education is concerned here, conditions are quite a bit different from those prevailing in the U.S. It takes between eight and ten years to complete the course for a practicing medical degree in Sweden. Medical courses are offered in the universities, and also in the two large state medical centers, each divided into a public health department, a hospital, and a series of institutes for medical education and rsearch. One of these state centers is Karolinska (Caroline) Institute in Stockholm, where I spent several days, and where Dr. Heden and Dr. Svartz in particular were extremely kind in showing me around. Karolinska Institute is an up-to-date institution somewhat on the scale of the Columbia University-Presbyterian Medical Center in New York City. The large routine laboratory of the hospital is very well equipped and able to handle a tremendous amount of routine work per day. I was interested to see, for instance, that although Sweden has only a small amount of aureomycin and almost no chloromycetin available, sensitivity tests and body fluid levels for these drugs had already been developed and were being applied.

Of much greater interest were the individual institutions. I visited two, the Institute for Cell Research, a Nobel establishment, and the King Gustav V Research Institute. At the cell research center Dr. Malmgren and Dr. Heden are engaged in studies on the nucleotide metabolism of bacteria. The biochemistry department works with isotopes, on tuberculosis, and on the isolation and study of respiratory enzymes. Optical studies on cell composition are in progress in the large and excellently equipped optical department. This boasts an American-made electron microscope, available also to the other research institutions of Stockholm, and good modern ultraviolet apparatus. The central optical department is separated from the rest of the house by air spaces between the walls to prevent vibration, and has collapsible walls so that rooms can be rearranged according to need. The three ultraviolet microscopes are used at present to study hemoglobin synthesis. A soundproof acoustical measuring room is also found.

The King Gustav V Research Institute was built and endowed with donations by the Swedish people at the 80th birthday of King Gustav V. His Majesty desired that the institute should devote a greater part of its energies to rheumatic disease investigations. Dr. Schwartz who heads the institute, impressed me as an extremely able scientist who, through her own boundless enthusiasm, energy, and vast knowledge of the field, led and inspired her co-workers' endeavors. Rheumatic diseases are studied from the bacteriological, serological, chemical, and physiological standpoints. The chemistry department studies the body fluid protein fractions as pertaining to rheumatic diseases, that is, both blood specimen and joint exudates. Dr. Svartz told me that they had been able to verify that the ß- and γ-globulin fractions in the blood of animals injected with living pneumococci, staphylococci, and enterococci cultures showed an agglutination against red sheep cells and that investigations along this line are continuing. The department owns a Swedish-made electron microscope and I was able to convince myself of its excellence by means of several pictures of untreated and penicillin-treated typhoid bacilli which I was shown. They were extraordinarily clear, taken at a magnification of 150,000 to 190,000 times, the untreated bacteria showing a wealth of morphological detail and the treated ones tremendously elongated, the cell body thinning and emptying.

Several other minor fields of research are pursued at the King Gustav V Institute. Dr. Nieman works on substances to decrease blood pressure, there is some allergy research, and plans have been made for virus work as soon as the virus laboratory is equipped. I came away from Karolinska with my head fairly whirling with the scientific activity I had seen there.

The oldest university in Sweden is Uppsala University, founded in the late 15th century, where arts and sciences are taught to about 4000 students. The Department of Hygiene and Bacteriology, where I was the guest of its head, Prof. Löfstrom, has been in existence since 1935. The department is housed in the new Pathology Building; eventually it is planned to separate the hygiene division and turn it into a preventive medicine department, so that the Bacteriology and Virus Department can spread out a bit and add courses to its teaching program. The department now offers a six-week clinical bacteriology course for freshmen medical students but hopes soon to add an additional course for more advanced students.

Prof. Löfstrom, who had been appointed only eight months ago, was kind enough to show me about and explain the research in progress. The department consists of its director, six associates and assistants, and about 20 technicians, who do routine diagnostic work from the university hospital and also help in the research in progress. When the planned virus department materializes, poliomyelitis and bacteriophage research will be done. Prof. Löfstrom is continuing his work on immunology, his associate is working on tuberculosis in relation to sensitivity tests to a Swedish antibiotic (PAS—*p*-aminosalicylic acid). Future work on immunology and quantitative measurements on airborne infections seem to be the main interests of the bacteriology department director and his co-workers.

In concluding this report from Sweden I should like to thank all the doctors who extended to me the hospitality of their institutes in such generous fashion. I hope that we in America will be able to reciprocate to some extent when we shall play host to them here.

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Book Reviews

Isotopic tracers and nuclear radiations: With applications to biology and medicine. William E. Siri. New York-London: McGraw-Hill, 1949. Pp. xiii + 653. (Illustrated.) $12.50.

This book is a completely rewritten version of "A. F. Technical Report No. 5669," originally prepared for the Army Air Forces. It is primarily a reference book for research workers and not suited as a text for students either in content or in price. Those who expect just another book on isotopes will be pleasantly surprised to find something much superior. It contains many sections which are solidly filled with useful material, concisely presented and conveniently arranged. The complete Seaborg and Perlman table of isotopes would make a lesser book top-heavy. Its inclusion here is taken for granted.

Over half of the book is devoted to physics. Here, where one expects the usual trivia, one finds instead an extremely thorough review of basic principles of nuclear physics, including a very comprehensive treatment of the interaction of ionizing radiations with matter. The method of presentation correctly ignores the historical approach and begins with the basic factors of nuclear stability. The inclusion of a section on neutron theory is perhaps to be expected, but no discussion of reactors follows. The text is liberally sprinkled with useful graphs and tables and each chapter is concluded with many literature references. A peculiar feature is that the names of many authors are consistently misspelled.

Although Part III, on the biological and medical applications, will soon be dated, this is the difficulty which any writer on this subject faces at the present time. Many will appreciate the fine bibliography of nearly 100 pages. A certain degree of organization has been achieved in a badly cluttered field. Chapter 29, on isotopes in therapy and diagnosis, is written with laudable restraint.

A few people will feel that the book is overbalanced in favor of physics, and that the treatment of such topics as radioautographs and hot laboratory technique is thus too brief. The chapter on the theory of tracer methods is incomplete, and one misses a section on radiation chemistry. Occasional misprints are found; on page 174, F^{m} should be Fe^{58}. In spite of these points, the book will be a very useful practical tool to the investigator and will certainly be found within close reach on many desks during the next few years.

C. W. SHEPPARD

Oak Ridge National Laboratory

Scientific Book Register

DOWSON, W. J. *Manual of bacterial plant diseases.* London (W.1): A. & C. Black, 1949. Pp. viii + 183. (Illustrated.) 16s. net.

FULLER, HARRY J., and TIPPO, OSWALD. *College botany.* New York: Henry Holt, 1949. Pp. xiv + 993. (Illustrated.) $5.75.

GOODENOUGH, FLORENCE L. *Mental testing: Its history, principles, and applications.* New York: Rinehart, 1949. Pp. xix + 609. (Illustrated.) $5.00.

HALE, WILLIAM J. *Farmer victorious: Money, mart, and mother earth.* New York: Coward-McCann, 1949. Pp. xii + 241. $3.00.

HERRICK, JAMES B. *Memories of eighty years.* Chicago: Univ. Chicago Press, 1949. Pp. ix + 270. (Illustrated.) $5.00.

HULL, GORDON FERRIE. *Elementary modern physics.* (Revision of *Elementary survey of modern physics.*) New York: Macmillan, 1949. Pp. xvi + 503. (Illustrated.) $5.25.

JACOBSON, C. A. (Ed.) *Encyclopedia of chemical reactions.* (Vol. III, cobalt through iridium.) New York: Reinhold, 1949. Pp. xi + 842. $12.00.

KRAMER, PAUL J. *Plant and soil water relationships.* New York: McGraw-Hill, 1949. Pp. xiii + 347. (Illustrated.) $4.50.

LAWRENCE, MERLE. *Studies in human behavior: A laboratory manual in general psychology organized to stress the basic principles of individual and group behavior with emphasis on perception.* Princeton, N. J.: Princeton Univ. Press, 1949. Pp. x + 184. (Illustrated.) $3.50.

LEVER, WALTER F. *Histopathology of the skin.* Philadelphia: J. B. Lippincott, 1949. Pp. xv + 449. (Illustrated.) $10.00.

MARTIN, JOHN H., and LEONARD, WARREN H. *Principles of field crop production.* New York: Macmillan, 1949. Pp. ix + 1176. (Illustrated.) $6.00.

MILLER, A. R. *The adsorption of gases on solids.* (Sequel to the Cambridge Physical Tract *Some problems in adsorption* by J. K. Roberts.) New York: Cambridge Univ. Press, 1949. Pp. viii + 133. (Illustrated.) $2.50.

Non-linear problems in mechanics of continua. (Proceedings of Symposia in Applied Mathematics, Vol. I.) New York: American Mathematical Society, 1949. Pp. vii + 219. (Illustrated.) $5.25.

ROBINSON, JUDITH. *Tom Cullen of Baltimore.* New York: Oxford Univ. Press, 1949. Pp. xii + 435. (Illustrated.) $3.50.

SCOTT, MERIT. *Mechanics: statics and dynamics.* New York: McGraw-Hill, 1949. Pp. xi + 394. (Illustrated.) $4.50.

NEWS and Notes

Lise Meitner, nuclear scientist, who fled from Berlin in 1938, has become a Swedish citizen. Dr. Meitner is at present conducting research at the Physics Institute of the University of Technology at Stockholm.

Albert M. Stone, special consultant to the Research and Development Board, has been appointed technical assistant to the director of the Applied Physics Laboratory, Johns Hopkins University, Silver Spring, Maryland. Dr. Stone was formerly scientific liaison officer in the London branch of the Office of Naval Research.

Robert K. S. Lim, former surgeon-general of the Chinese Nationalist Army, has been appointed visiting research professor at the University of Illinois College of Medicine. Dr. Lim will continue his research on the gastrointestinal hormone "enterogastrone."

Willis H. McCann, clinical psychologist at State Hospital No. 2, St. Joseph, Missouri, has been appointed clinical professor of psychology at the University of Kansas City. Dr. McCann will retain his present position at the State Hospital and will teach courses in psychopathology and psychotherapy.

Bernd T. Matthias, German physicist, has been appointed an assistant professor of physics at the University of Chicago. During the winter quarter he will teach classes in elasticity and hydrodynamics. Dr. Matthias has been working on synthetic crystals at the Bell Telephone Laboratories in Murrayhill, New Jersey.

George H. T. Kimble, chairman of the Department of Geography at McGill University, Montreal, and secretary of the International Geographical Union, has been appointed director of the Council of the American Geographical Society of New York. He will assume his new duties in June, succeeding **John K. Wright,** who has resigned after 11 years as director.

Ralph W. Bost, Smith Professor of Chemistry and head of the Department of Chemistry, University of North Carolina, has been elected chairman of the American Chemical Society's Division of Organic Chemistry.

Tze-Tuan Chen was appointed associate professor of zoology at the University of Southern California, giving courses in genetics, cytology, and general zoology. He assumed his duties last September first.

M. M. Wintrobe, professor of medicine, University of Utah School of Medicine, will deliver the fourth Harvey Lecture of the current series at the New York Academy of Medicine on January 19. Dr. Wintrobe will speak on "Factors and Mechanisms in the Production of Red Corpuscles."

Horace L. Hodes, formerly associate professor of pediatrics at Johns Hopkins University and member of the staff of the Rockefeller Institute, has been named chief of pediatrics at Mount Sinai Hospital in New York City. Dr. Hodes will continue his research in infant diarrhea in the hospital's new pediatric laboratory.

George G. Brown, chairman of the Department of Chemical and Metallurgical Engineering at the University of Michigan, has been named director of the U. S. Atomic Energy Commission's Division of Engineering. Dr. Brown will join the AEC staff on a full-time basis in the spring. As director of engineering, he will be responsible for the chemical engineering phases of the AEC's reactor development program.

Visitors to U. S.

Mary Collins, of the George Combe Psychological Laboratory, University of Edinburgh, will spend the spring semester as visiting professor in the Department of Psychology at Swarthmore College.

G. L. Hammond, of the British Ministry of Supply, London, and **M. Nagaoka,** president of the Japan Optical Company, Tokyo, recently conferred with members of the National Bureau of Standards.

Joaquin V. Luco, of the Catholic University, Santiago, Chile, has been named visiting professor in physiology at the Long Island College of Medicine. Dr. Luco succeeds **Oscar Orias,** who has returned to his institute at Cordoba, Argentina.

Fellowships and Prizes

The National Foundation for Infantile Paralysis is offering postgraduate research fellowships for one to three years in the fields of virology, orthopedic surgery, pediatrics, epidemiology, and neurology. These fellowships are available to qualified candidates whose objectives are research and teaching in these fields. Eligibility requirements include U. S. citizenship, sound health, an M.D. or Ph.D. degree, two years' residency training in the specialty, and a program of study and detailed plan of investigation. Financial benefits will be arranged according to individual needs. Additional information and applications may be obtained from Professional Education Division, The National Foundation for Infantile Paralysis, 120 Broadway, New York 5.

The American Society for the Study of Sterility is offering an annual award of $1,000 known as the Ortho Award, for an essay on the result of clinical or laboratory research pertinent to the field of sterility. Competition is open to those in clinical practice as well as to those whose work is restricted to research in basic fields or to full-time teaching. The prize essay will appear on the program of the forthcoming meeting of the society, which is to be held in San Francisco on June 24 and 25. Full particulars may be obtained from Dr. Walter W. Williams, Secretary, 20 Magnolia Terrace, Springfield, Massachusetts. Essays must be in his hands by *April 1.*

Grants and Awards

The Académie des Sciences of the Institut de France has awarded the

1949 Binoux Prize in the History and Philosophy of the Sciences to J. M. D. Olmsted, professor of physiology, University of California, for his biographies of the three French physiologists, Claude Bernard, François Magendie, and Charles-Édouard Brown-Séquard.

The A. Cressy Morrison Prize of $200 was awarded this month by the New York Academy of Sciences to Harold R. Hagan of the Biology Department, College of the City of New York. Dr. Hagan won the award for his monograph "Embryology of the Viviparous Insects."

Robert Cushman Murphy, Lamont Curator of Birds, American Museum of Natural History, has been awarded the **Raimondi Medal of the Geographical Society of Lima,** in recognition of his pioneer ecological investigations in the coastal waters of Peru. Dr. Murphy's medal is for the year 1946 and constitutes his second honor from Peru. In January, 1925, he received the degree of *Doctor honoris causa* from the University of San Marcos.

The 1950 Albert Victor Bleininger Award, conferred by the Pittsburgh Section of the American Ceramic Society for "distinguished achievement in the field of ceramics," will be presented to Stuart M. Phelps, senior fellow, Mellon Institute, and director of research and tests, American Refractories Institute.

The 1949 Pittsburgh Award of the American Chemical Society's Pittsburgh Section has been presented to H. V. Churchill, chief analytical chemist of the Aluminum Company of America.

Colleges and Universities

The Massachusetts Institute of Technology recently announced receipt of industrial grants-in-aid totaling $800,000, including $250,000 from the United Fruit Company of Boston, $50,000 from an unnamed Massachusetts corporation, $250,000 from the Cities Service Research and Development Company of New York, and $250,000 from the Standard Oil Company of California.

A collection of several thousand scientific and medical books was presented this month to **Hebrew University,** Jerusalem, by the U. S. government. The books, valued at $25,000, are the first installment of a $250,000 collection to be given to the university as a perpetual loan from this country.

A Department of Biophysics has been established in the **University of Pittsburgh's Division of Research in the Natural Sciences.** The new department was made possible by a $45,000 grant-in-aid from the Sarah Mellon Scaife Foundation to the university for the purpose of expanding and stabilizing its biophysics program over a three-year period.

Columbia University's Department of Civil Engineering has received a $7,000 grant from the Research Corporation for a research program dealing with the fundamental aspects of mechanical behavior and properties of engineering materials. The investigation will be under the direction of Alfred M. Freudenthal, who has planned and directed research in the fatigue of metals in cooperation with the Office of Naval Research. William J. Krefeld, director of the school's Civil Engineering Research Laboratories, will coordinate the research program with other projects now being carried out in the department.

Cornell University Medical College and the Cornell University-New York Hospital School of Nursing will begin an experimental program in February to determine the possible reciprocal advantages of joint studies between the social sciences and medical and nursing education. The project is being carried on in cooperation with the Russell Sage Foundation and is expected to continue for a period of about two years. Leo W. Simmons, associate professor in the Department of Sociology, Yale University, has been granted leave of absence to direct the work.

Meetings and Elections

A Symposium on Dental Caries Control was presented before the recent meeting of the Association of Military Surgeons of the United States in Washington, D. C. on November 11. All aspects of tooth decay prevention were evaluated by the participants from the standpoint of their special fields of research. Rear Admiral C. V. Rault, chief of the Navy Dental Corps, presided. The first speaker, Frank J. Orland of the University of Chicago, stressed that the evidence that certain bacteria, particularly those capable of producing large quantities of lactic acid in a short time, are associated with the carious process is only circumstantial or indirect. Furthermore, direct evidence bearing on this point is needed for final proof of the etiological reationship of bacteria, such as lactobacilli, to dental caries. When the causative agents of dental caries are eventually established, only then, can antibacterial substances be used with greater specificity, and therefore effectiveness, in the prevention of tooth decay.

The next participant, Joseph F. Volker, University of Alabama, emphasized the dietary reduction of refined carbohydrates as a caries control measure. Some evidence has been accumulated to show that, among hamsters, the diet of the mother is an influencing factor upon the caries susceptibility of the molar teeth of offspring. Whether this finding has a bearing on human beings is problematical. Francis A. Arnold, Jr., of the U. S. Public Health Service, discussed the historical aspects of the findings that a low concentration of fluoride in the water intake of growing individuals can reduce the incidence of dental caries. Topically applied sodium fluoride has also been shown to be effective in animals and man, if properly applied. The Public Health Service study of the caries incidence in Grand Rapids, where one part per million of sodium fluoride has been added to the communal water supply, has not yet advanced far enough to indicate any definite trend as to caries reduction in the children examined, Arnold pointed out.

As final speaker, Basil G. Bibby, of the Eastman Dental Dispensary, stated that almost no acceptable studies had ever been made showing that brushing of teeth had any correlation with the reduction of dental decay. He mentioned the innumerable therapeutic dentifrices tried, but stressed only those containing penicillin as having some promise of success in curtailing tooth decay on the basis of studies in animals and groups of children. Discussion of these four presentations followed.

F. J. ORLAND

Geological Field Conference on the Mississippi River Valley. An invitational field conference on the late Cenozoic geology and geological history of the Mississippi River Valley was held June 12–25, under the auspices of the state geologists of the states concerned—Arkansas, H. B. Foxhall; Illinois, M. M. Leighton; Iowa, H. G. Hershey; Kentucky, D. J. Jones; Louisiana, L. W. Hough; Mississippi, W. C. Morse; Missouri, E. L. Clark; Tennessee, H. B. Burwell. The leaders were: for Iowa, A. C. Trowbridge and H. G. Hershey, for Illinois to Mississippi, M. M. Leighton and H. B. Willman, and for Louisiana, G. E. Murray and Leo Hough. The purpose of the conference was to enable geologists and pedologists to review together the field phenomena, beginning in southeastern Iowa and extending to south-central Louisiana.

The contrast in features of the upper and lower segments of the Mississippi River Valley has always been of outstanding interest in North American geology, but it has been recognized that despite this contrast their development has been harmoniously interrelated. Recent interpretations of the Lower Valley, however, are quite different from and incongruous with the prevailing concepts of the Upper Valley. The conference contributed substantially to a more harmonious interpretation of the valley as a whole and focused attention on problems to be further investigated.

The more important subjects given consideration were: the preglacial, high level chert gravels beneath the glacial drift in the Upper Valley and their relation to similar gravels south of the drift border; the drift-sheets laid down by the various continental glaciers and the evidences of their relative ages; the succession of the loess formations and the evidences of their relative ages and origin; the valley-train terraces, especially those of Wisconsin age, and their relation to the alluvial fill of the Lower Mississippi; the evidences of the alternating character of the glacial melt waters, aggradational to torrential, and the causes therefor; and Pleistocene changes in drainage.

A total of 45 persons, most of them specialists and representing universities and state and federal surveys, participated in the conference. Geologists and pedologists found common ground in the problems considered—particularly in the alteration of sediments by weathering and soil-making processes and in the recognition of their primary origin. The significance of profiles of weathering in the determination of relative ages of the sediments impressed everyone during the course of the conference as being a matter of major importance. Failure heretofore to recognize such phenomena and their significance accounts for some of the differences in interpreta tion of the geological history of the valley.

The conference was probably one of the most comprehensive field conferences ever held. A similar trip in the Missouri Valley area is contemplated by the geologists of that area within a year or so.

[The authors have in preparation a paper dealing with the late Cenozoic geology of southern Illinois.]

M. M. LEIGHTON AND
H. B. WILLMAN

A conference on the Use of Tracers in Organic Reaction Mechanism Studies will be held at Brookhaven National Laboratory January 19–20. Speakers and their topics are as follows: Thursday—*B. M. Tolbert,* University of California, Reaction Mechanism Studies Using Carbon 14: I. The Decomposition of Acetyl Peroxide in Acetic Acid (with A. Fry and M. Calvin), II. The Preparation of Demerol by Reductive Methylation and the Role of Formaldehyde and Formic Acid in this Reaction (with W. Tarpey, H. Hauptmann, and H. Rapoport); *Knut A. Krieger,* University of Pennsylvania, Mechanism of Acetylene Oxidation over Silver Nitrate; *Aksel A. Bothner-By,* Brookhaven National Laboratory, Studies using C^{13} of Natural Abundance (with J. Bigeleisen and L. Friedman); *O. Kenton Neville,* Oak Ridge National Laboratory, C^{14} Tracer Studies in the Rearrangement of α-Diketones: III. The Rearrangement of Unsymmetrical Benzils; *Robert B. Loftfield,* Harvard University, Mechanism of Faworski Reaction; Friday—*William H. Hamill,* University of Notre Dame, Primary Processes Involving Radiobromine at the Carbon-Carbon Double Bond; *Russell R. Williams, Jr.,* University of Notre Dame, The Detection and Identification of Free Radicals by Use of Radiohalogens; *John D. Roberts,* Massachusetts Institute of Technology, Rearrangements of Carbon Atoms in Alkyl Derivatives; *Elliot R. Alexander,* University of Illinois, Mechanism of Catalytic Hydrogenalysis; and *Martin Gibbs,* Brookhaven, The Mechanism of the Alkaline Degradation of Glucose. Information concerning housing and transportation may be obtained from Mrs. M. Kuper, Director's Office, Brookhaven National Laboratory, Upton, New York.

A conference on polluted irrigation waters, sponsored jointly by the Environmental Health Study Section of the National Institutes of Health, the El Paso Health Department, and the Texas State Health Department, will be held January 27 in El Paso. The program will be devoted to discussions of general problems of irrigation waters in several western and southwestern states; current research in the incidence and behavior of pathogenic organisms in irrigation waters, vegetable washings, and soils; and epidemiological aspects of sewage-polluted irrigation waters; in addition, papers will be presented on the utilizaton of waste water, impounding and use of water of the Rio Grande, machines for vegetable washing, present standards for irrigation water, and use of

sewage sludges for soil improvement. Copies of the program may be obtained from Mr. Irving Gerring, Executive Secretary, Environmental Health Study Section, Division of Research Grants and Fellowships, National Institutes of Health, Bethesda 14, Maryland.

The Twelfth Annual Midwest Power Conference, sponsored by the Illinois Institute of Technology with the cooperation of 18 midwestern universities and professional societies, will be held April 5–7 at the Sherman Hotel, Chicago. The theme of the conference will be "Economy in Power."

The following officers were elected at the fifth session of the **International Union for Scientific Study of Population,** held at Geneva August 27–September 2: president, L. Hersch, Switzerland; vice presidents, D. V. Glass, United Kingdom, L. Livi, Italy, A. J. Lotka, U. S., K. B. Madhava, India, G. Mortara, Brazil, A. Sauvy, France, S. Szulc, Poland; and secretary general and treasurer, G. Mauco, France. They will serve until the next meeting of the assembly.

Charles Allen Thomas, executive vice president of the Monsanto Chemical Company, St. Louis, has been elected chairman of the Board of Directors of the American Chemical Society, to take office January 1. Dr. Thomas succeeds **Roger Adams,** chairman of the Chemistry Department of the University of Illinois and president elect of the AAAS, who has served three consecutive terms as director, the maximum term permitted by the society's constitution.

Deaths

William Alexandre Perlzweig, professor of biochemistry and chairman of the department at Duke University, died of cancer on December 10. Dr. Perlzweig, who was 58 at the time of his death, had made extensive studies of the metabolism of the vitamins of the B complex. He was a special adviser to Hebrew University Hadassah Medical School, Jerusalem.

Arthur Parker Hitchens, 72, Commissioner of Health in Wilmington, Delaware from 1945 to 1948, and former George S. Pepper Professor of Preventive Medicine at the University of Pennsylvania, died at his home in Philadelphia on December 10. As a member of the Research Board of the U. S. Medical Department in Manila, 1924–25, Dr. Hitchens participated in the organization of the School of Public Health and Preventive Medicine at the University of the Philippines.

Samuel R. Haythorn, pathologist and director of the William H. Singer Research Laboratory at Allegheny General Hospital in Pittsburgh, died on December 6 at the age of 69. Dr. Haythorn, who was formerly head of the Department of Pathology and Bacteriology at the University of Pittsburgh, was known for his research in tuberculosis, silicosis, and cancer.

A health protection clinic, where anyone over 18 years of age may receive free tests for detecting disease or disability in early stages, will be opened in Boston on January 3. It is the first of five such clinics, located in pivotal areas throughout the state, to be sponsored by the Massachusetts Medical Society with the cooperation of the Massachusetts Department of Public Health and voluntary agencies. Claire F. Ryder, epidemiologist with the State Health Department, has been appointed administrator. The cost of the clinic for a six-month period is estimated at $30,000, of which the U. S. Public Health Service will supply $15,000 for clinic personnel and the Massachusetts Department of Public Health will provide $12,000. The balance will come from voluntary agencies, of which the American Cancer Society will donate $1,250.

Radioisotopes may now be obtained under the Canadian export program. The Isotopes Division of the U. S. Atomic Energy Commission has been named the coordinating agency for the import of Canadian radioisotopes, as it is for the domestic distribution and export of U. S.-produced isotopes. Applications may be made to the division, P. O. Box E, Oak Ridge, Tennessee.

Recently Received—

Recent Developments in Hawaiian Land Utilization. E. O. Kraemer. Paper No. 51. University of Hawaii, Honolulu, T. H.

How to Collect and Preserve Insects. H. H. Ross. Circ. 39, Illinois State Natural History Survey, Urbana, Illinois.

Preserving Birds for Study. Emmet R. Blake. Fieldiana: Technique No. 7. Chicago Natural History Museum.

Effects of Oil Mixed with Carbonized Sand on Aquatic Animals. Special Scientific Report: Fisheries No. 1. Fish and Wildlife Service, U. S. Department of Interior, Washington 25, D. C.

National Academy of Sciences Biographical Memoirs, Vol. XXV. National Academy of Sciences, Washington, D. C.

Recommended Nutrient Allowances for Horses. No. VI, Recommended Nutrient Allowances for Domestic Animals. Committee on Animal Nutrition, National Research Council, 2101 Constitution Avenue, Washington 25, D. C.

Short Periodic Solar Variations and the Temperatures of Washington and New York. C. G. Abbot. Smithsonian Miscellaneous Collections, Vol. 111, No. 13, Publ. 3990. Smithsonian Institution, Washington, D. C.

The Quest for Stellar Parallax. Dorrit Hoffleit. Harvard reprint 321. Harvard Observatory, Cambridge, Massachusetts.

The Standard Cepheid Light Curve. Harlow Shapley. Harvard Reprint 29, Series II. Harvard Observatory, Cambridge, Massachusetts.

The Birefringent Filter. John W. Evans. Harvard reprint 30. Harvard Observatory, Cambridge, Massachusetts.

The Black Rock Forest Twenty-Year Progress Report, 1928–48. Bull. No. 14. Henry H. Tryon and Raymond F. Finn. Cornwall-on-the-Hudson, New York.